Pit and Fissure Sealants in the Prevention of Dental Caries in Children and Adolescents: A Systematic Review

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Objectifs : Examiner les données sur l'efficacité des scellants comme moyen de prévenir la carie chez les enfants et les adolescents et, en présence de preuves à l'appui adéquates, élaborer un protocole sur l'application des scellants.

Méthodologie : Les précédents examens systématiques sur le sujet ont servi de base au présent examen. Ovid MEDLINE, CINAHL et plusieurs autres bases de données bibliographiques pertinentes ont été consultées, à la recherche d'articles publiés en anglais, avec des sujets humains, entre 2000 et 2007.

Résultats : La recherche documentaire a permis de recenser 303 articles dont la pertinence a été évaluée à partir du titre et du sommaire. Trente-huit recherches originales satisfaisaient aux critères d'inclusion. Ces articles ont été lus en intégralité et notés par 2 examinateurs indépendants, et les données probantes en ont été extraites aux fins de la formulation des recommandations.

Recommandations : Les recommandations qui suivent sont basées sur les données recueillies durant cet examen :

1. Les scellants devraient être appliqués sur toutes les molaires permanentes exemptes de cavités (c.-à-d. les molaires permanentes exemptes de caries, celles qui présentent une morphologie de puits et fissures profonds, celles dont les fissures accrochent au passage de la pointe de l'explorateur ou celles dont les sillons sont tachés) peu après l'éruption, de manière à pouvoir isoler la dent.
2. Les scellants ne devraient pas être appliqués sur des dents dont l'éruption n'est pas complète ou des dents qui présentent des cavités ou des caries de la dentine.
3. Des scellants devraient être appliqués sur les molaires primaires des enfants sensibles aux caries (c.-à-d. ceux ayant des antécédents de caries).
4. Des scellants devraient être appliqués sur les premières et deuxièmes molaires permanentes dans les 4 ans suivant leur éruption.
5. Utiliser de préférence des scellants à base de résine, en attendant la mise au point de ciments de verre ionomère offrant une meilleure capacité de rétention.
6. L'application de scellants devrait s'inscrire dans une stratégie globale de prévention basée sur l'évaluation du risque de caries.

Pour les citations, la version définitive de cet article est la version électronique : www.cda-adc.ca/jcda/vol-74/issue-2/171.html

Pit and fissure sealants (ultraviolet-activated, autopolymerized or light-cured resin-based [RB] sealants and glass ionomer cement [GIC] sealants) were first developed in the 1970s and 1980s, and their effectiveness in preventing caries has now been established by randomized clinical trials.[1–4] Some evidence has also accumulated to indicate that RB sealants have higher retention rates than GIC sealants.[5,6]

Table 1 Numbers of articles identified, retrieved and used in developing recommendations

Type of study	Identified	Rejected on basis of title or abstract	Retrieved	Critically appraised and scored	Articles providing evidence
Efficacy study	82	44	38	38	25
Guideline	174	157	17[a]	0	0
Study of costs	12	0	12[a]	0	0
Secondary search (references)	35	7	28[b]	0	0
Total (duplicates removed)	303	208	95	38	25

[a]*None of the guidelines or studies of costs were scored or used as evidence for this review.*
[b]*No additional original studies were identified through the secondary search.*

The most recent Cochrane reviews[1,7] concluded that the information available at the time of the reviews (2004 and 2006) was insufficient to determine whether fissure sealants or fluoride varnishes are the most effective measure for preventing caries, although there was some evidence that pit and fissure sealants are superior to fluoride varnishes for the prevention of occlusal caries.

To update previously published reviews on this topic (the Cochrane review[1] and a review by the University of Toronto's Community Dental Health Services Research Unit [CDHSRU][2]), the present systematic review was undertaken with the aim of developing a scientifically current and evidence-based protocol. More specifically, the authors have attempted to answer the following questions:

- Who should receive sealants?
- Should dental sealants be placed on primary or permanent teeth (or both), and if so, at what age?
- How important is isolation?
- What materials should be used?
- How can retention of sealants be enhanced?
- Do sealants reduce caries increments?
- Are dental sealants cost-effective?

For the purposes of this study, it was assumed that any benefit in terms of improved health outcomes had to be both clinically (i.e., the smallest difference that clinicians and patients feel represents an improvement in oral health or wellness) and statistically ($p < 0.05$) significant; if there is no benefit at the threshold of both clinical and statistical improvement, then the procedure should not be used for that purpose.

Methods

Database Search

The following databases were searched for relevant articles about sealants and sealant guidelines, published between 2000 and 2007: Ovid MEDLINE (In-Process and Other Non-Indexed Citations, Daily Update), CINAHL (Cumulative Index to Nursing and Allied Health Literature), the Evidence Based Medicine section of the Cochrane Central Register of Controlled Trials, the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effects, EMBASE, Health and Psychosocial Instruments, HealthSTAR, International Pharmaceutical Abstracts, Journals@Ovid and *ACP Journal Club*.

Inclusion Criteria

The searches were limited to articles in English and those concerning humans. Other inclusion criteria were age 0 to 18 years (which resulted in no change in citations identified) and year of publication from 2000 to 2007 (the Cochrane review[1] and the CDHSRU review[2] covered the literature up to 2000).

Search Strategy

The subject heading "pit fissure sealant" was combined with several key word terms: dental fissure and prevention or effectiveness or dental caries or tooth decay or caries susceptibility or tooth surface or caries incidence or caries prediction or caries assessment or past caries or caries risk assessment. Articles were retrieved using the appropriate search strategy for each database. The results of the literature search are summarized in **Table 1**.

A total of 303 articles and their abstracts, including guideline articles, were reviewed initially. This total included review articles, which were retrieved and reviewed for their conclusions and to identify additional citations. Reference lists were checked to identify any other articles that might provide information relevant to the research question. Articles that did not address the efficacy of dental sealants or protocols for the use of sealants or that did not provide background information (review articles) were excluded. After removal of duplicates, the total number of articles selected for detailed review was 38 (**Table 1**). The 2 authors independently assessed the search strategy at each stage, critically reviewed each selected article and rated the level of evidence according to the classification developed by the Canadian Task Force on Preventive Health Care.[8] This system includes a hierarchy of evidence, from the highest (level I; properly randomized controlled trials) to the lowest

(level III; opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees). The system also includes a bidirectional classification of recommendations for specific clinical preventive actions (grades A to E and grade I, with grade A representing good evidence to recommend *for* the clinical preventive action, grade E representing good evidence to recommend *against* the clinical preventive action, and grade I representing insufficient evidence, in quantity and/or quality, to make a recommendation).

All 38 articles were retrieved and scored using the University of Toronto faculty of dentistry "Checklist to Assess Evidence of Efficacy of Therapy or Prevention."[9] This checklist consists of questions addressing ethics, study design, methodology and appropriateness of the results to the population of interest. Only studies with a score of at least 10 (out of a maximum score of 16) were included. This process reduced to 25 the number of articles providing evidence for this review. Recommendations for the use of dental sealants for caries prevention were developed on the basis of evidence in the included articles. The level of evidence and the recommendations for each article are given in **Appendices 1** and **2** (see www.cda-adc.ca/jcda/vol-74/issue-2/171.html). In addition, information on techniques and materials used was extracted from the studies and is presented in **Appendix 3** (see www.cda-adc.ca/jcda/vol-74/issue-2/171.html).

Results

Who Should Receive Sealants?

The literature[5,10–37] strongly recommends the use of sealants for children after eruption of molar teeth. There seems to be a benefit in placing sealants within 4 years after eruption. There is no body of knowledge advocating the use of sealants beyond adolescence (level of evidence I, grade of recommendation A; **Appendices 1** and **2**).

The CDHSRU review[2] assessed the following 2 risk factors: past caries experience (where susceptibility to onset of further caries was positively associated with a child's previous dmfs/DMFS scores[38–44]) and pit and fissure morphology (where children who had deep pits and fissures were at greater risk for dental decay on these features). The authors of the review also found that permanent molars appeared to remain at high risk for dental decay beyond 4 years after eruption.[45–52] However, this apparent association is still inconclusive because of the relatively few studies that have been conducted, differences in the age cohorts studied, variability in diagnostic techniques applied and differences in the treatment thresholds of participating dentists.

There is agreement that in high-risk populations such as First Nations and Inuit groups, all children should receive sealants.[5,12,15,16,18–20,22] For low-risk populations, the recommendation is to seal the molar teeth of susceptible children, i.e., those who already have caries at the time of assessment, those who are medically compromised and others at risk (**Appendices 1** and **2**).

Should Dental Sealants be Placed on Primary or Permanent Teeth (or Both), and if so, at What Age?

The literature strongly supports the placement of sealants on permanent molar teeth as both cost-effective and efficacious in the prevention of caries (level of evidence I, grade of recommendation A; **Appendix 1**).[45–52] The literature also supports the placement of sealants on primary molars,[53,54] although the supporting evidence is more limited (level of evidence I, grade of recommendation A; **Appendix 2**). Chadwick and others[55] found that sealing primary teeth with GIC sealants was of little value in preventing caries.

How Important is Isolation?

In terms of retention and the need to reassess sealants within a year after placement, it is very important to adequately isolate the teeth. Salivary contamination is the major cause of loss of sealants in the first year (**Appendices 1** and **2**).[2,10]

What Materials Should be Used?

Various materials have been used to seal permanent molar teeth (**Appendix 3**). Five studies[5,14,15,19,21] compared RB and GIC sealants, but the results were mixed, depending on whether regular or reinforced GICs were tested. The best retention rates were obtained with the RB sealants, which had retention rates 2%–80% better than the GIC sealants. Retention is a major problem with GIC sealants, but if this concern can be resolved, there may be advantages to the GIC sealants through the release of fluoride. Additional research is required in this area.

How Can Retention of Sealants be Enhanced?

Retention can be enhanced by isolation of the teeth, use of RB materials, application of sealants after complete eruption (i.e., once there is no gingival tissue on the crown) and good operator techniques and protocols (**Appendix 3**). Other methods have been used to enhance retention, such as application of bonding agents,[10,12] use of flowable resin,[14] pretreatment with an adhesive[11] and air abrasion following fissure preparation with phosphoric acid gels.[22,23]

Do Sealants Reduce Caries Increments?

There is clear evidence of the reduction of caries increments with satisfactory placement of sealants.[5,10–28,30,56] For example, Beiruiti and others,[19] in a study of 103 schoolchildren, found that the relative risk of caries with GIC compared with RB sealants was 0.22, 0.32 and 0.28 at 3, 4 and 5 years after placement, respectively. Others[10,20] have shown excellent protection from caries with the use of sealants over long periods (5 and 9 years, respectively). Many other studies with similar results are included in **Appendices 1** and **2**. There is also clear evidence of a

reduction in caries increments (by up to 50%) when any kind of sealant application was compared with placebo controls (either no treatment, fluoride varnish or mouth rinse treatment, or oral hygiene instructions).[15,18,20,23,30,54,55]

Are Dental Sealants Cost-Effective?

When evaluating the cost-effectiveness of any preventive intervention such as dental sealant, the costs of the intervention (consisting of both the direct costs, such as costs of materials, administration and quality assurance, and the indirect costs, such as the patient's travel time and time off work) are weighed against the benefits (i.e., reduction in caries, reduction in number of dental visits and procedures, and long-term effects, such as changes in the need for restorations and improvement in quality of life).

The search strategy used in this review identified 6 studies evaluating the cost-effectiveness of sealants. These studies considered the following aspects: time needed to apply the sealant,[57] methods of cost minimization in field trials,[58] cost-effectiveness of a school-based program in which dental auxiliary personnel applied the sealant,[59] cost-effectiveness of provision of free primary oral health care services to all public school children with low socioeconomic status,[60] cost-effectiveness of Medicaid expenditures for first permanent molars with or without dental sealants[61] and cost-effectiveness of 3 sealant delivery strategies (provide sealant for all children, provide sealant only for at-risk children, provide no sealant for any children).[62] Two of these studies are described in more detail below.

In a retrospective cohort study of children enrolled in the North Carolina Medicaid program, Weintraub and others[61] compared the likelihood of need for restorative treatments and associated Medicaid expenditures for first permanent molars with and without dental sealants. Over the period 1985 to 1992, the dental experience of 15,438 children was assessed on the basis of administrative files and Medicaid dental claims. Regression analyses were used to assess outcomes (specifically, caries-related services involving the occlusal surface [CRSOs] of permanent first molars) and cumulative expenditures, controlling for characteristics of the child, characteristics of the treating dentist and the child's county of residence. Sealant and restoration rates in this cohort were low: 23% of children and 19% of first molars underwent at least 1 sealant treatment, and one-third of the children and only 20% of first molars received at least 1 CRSO. Unsealed molars were almost 3 times more likely than sealed molars to receive a CRSO (22.2% vs. 7.9%) Effectiveness was highest for children with greater levels of CRSOs before placement of the sealant. Estimated cumulative Medicaid expenditures indicated that, for high-risk children with 2 or more prior CRSOs, application of sealant was associated with savings in the following 2 years.

Griffin and others[62] analyzed the cost-effectiveness of 3 sealant delivery strategies: provide sealant for all children ("seal all" or SA), provide sealant for children assessed to be at risk by screening (TARGET) and provide no sealant for any children ("seal none" or SN). The authors based their analysis on the following assumptions and findings from previously published studies: a 9-year analytic horizon, a 3% discount rate and zero screening costs. They estimated the costs of sealant (US$27.00 per sealant) and restorations (US$73.77 per restoration), annual caries increment (0.0624 surfaces), sealant failure rate (20% in year 1 and 3% each year thereafter), annual rate of amalgam failure (4.6%), and sensitivity (0.635) and specificity (0.795) of screening. They calculated the incremental cost, incremental effectiveness and incremental cost-effectiveness for the following comparisons: SA vs. TARGET, SA vs. SN, and TARGET vs. SN. They found that the TARGET approach was more cost-effective (lower cost and lower incidence of caries) than the SA and SN approaches. To examine the stability of these rankings, they performed 1-, 2-, and 3-way sensitivity analyses, which showed that if annual caries increment exceeded 0.095 surfaces, SA was the least costly strategy, whereas if caries increment exceeded 0.05 surfaces but was less than or equal to 0.95, the TARGET approach was least costly. The sensitivity analysis for cost showed that if sealant costs were lower than the reported cost of US$6.00 for school programs, the TARGET approach dominated the SN approach for caries increments exceeding 0.007 surfaces, whereas the SA approach dominated the TARGET approach for caries increments exceeding 0.034 surfaces.

Conclusions

In addition to reviewing the literature published since 2000, we reviewed evidence-based reviews from the Cochrane Collaboration and the University of Toronto's CDHSRU[1,2,7]; guidelines and position statements from the American Dental Association,[63] the British Society of Paediatric Dentistry,[64,65] the U.K. National Clinical Guidelines in Paediatric Dentistry,[66] the European Academy of Paediatric Dentistry,[67] and the American Academy of Pediatric Dentistry[68,69]; and other review articles.[4,6,7,70–80] Evidence derived from this literature led to the following conclusions and recommendations.

Effectiveness of Sealants

1. This review has confirmed the efficacy of dental sealants in preventing dental caries in children, in both primary and permanent teeth (level of evidence I, grade of recommendation A).
2. There is some evidence that placing sealant material over arrested caries or incipient lesions does not increase the risk of further development of caries under the sealant (level of evidence I, grade of recommendation A).
3. There is continuing evidence of the importance of isolation for retention.

4. There is good evidence of the need to review retention at least annually (level of evidence I, grade of recommendation A).
5. There is evidence that RB materials are more effective than GIC materials (level of evidence I, grade of recommendation A).

Cost-effectiveness

RB sealants are more effective and cost about the same as GIC sealants. The cost-effectiveness of any public health strategies for preventing caries can be improved by assessing the risk of caries and targeting high-risk children.

Recommendations

The following recommendations are based on the evidence gathered in this review:

1. Sealants should be placed on all permanent molar teeth without cavitation (i.e., permanent molar teeth that are free of caries, permanent molar teeth that have deep pit and fissure morphology, permanent molar teeth with "sticky" fissures, or permanent molar teeth with stained grooves) as soon after eruption as isolation can be achieved.
2. Sealants should not be placed on partially erupted teeth or teeth with cavitation or caries of the dentin.
3. Sealants should be placed on the primary molars of children who are susceptible to caries (i.e., those with a history of caries).
4. Sealants should be placed on first and second permanent molar teeth within 4 years after eruption.
5. RB sealants should be preferred, until such time as GIC sealants with better retention capacity are developed.
6. Sealants should be placed as part of an overall prevention strategy based on assessment of caries risk. Other preventive measures include application of fluoride varnish, education, nutritional counselling and regular clinical review (at least annually, but semi-annually wherever possible).

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Editor's note: Recommendations 1 and 4 in the abstract and in the conclusion of this article were modified to specify that sealants should be placed on permanent molar teeth. *(Modified web version posted May 7, 2008)*

Appendix 1 Efficacy of pit and fissure sealants for permanent teeth: included studies

Citation: Poulsen S, Laurberg L, Vaeth M, Jensen U, Haubek D. A field trial of resin-based and glass-ionomer fissure sealants: clinical and radiographic assessment of caries. *Community Dent Oral Epidemiol.* 2006; 34(1):36–40.

Population: 153 children with at least one pair of sealed permanent molars (364 site-pairs) and a set of bitewing radiographs. All were enrolled in the dental service and would receive free, systematic care from birth until 18 years of age. Sound surfaces and surfaces with initial or arrested caries (white or brown fissures) were sealed, if the dentist's clinical assessment indicated a caries risk.

- Age: 8–13 years
- Sex: Not mentioned
- Location: Municipality of Værløse (0.25 ppm fluoride in water), located 15 km north of Copenhagen, Denmark, over the period 1996–2001
- Representative of schoolchildren with free access to public oral health care

Intervention: Fuji III glass ionomer sealant (GC Corporation, Tokyo, Japan). Children born on even dates had Fuji III placed on teeth in the right side of the mouth (both upper and lower); the opposite procedure was used for children born on odd dates.

Control: Delton ultraviolet-light-cured opaque resin-based sealant (Ash Dentsply, York, Penn.). Children born on even dates had Delton placed on teeth in the left side of the mouth (both upper and lower); the opposite procedure was used for children born on odd dates.

Outcomes: Mean follow-up time: 38–39 months for sites on first permanent molars and 28–29 months for sites on second permanent molars; n = 364 site-pairs or a total of 728 sealed sites.

Complete retention:

- Delton: 60%–80%
- Glass ionomer cement: < 10%

Caries development in Delton vs. GIC:

- Clinical diagnosis: relative risk (RR) = 0.435 (95% confidence interval [CI] 0.150–0.846)
- Radiographic diagnosis: RR = 0.559 (95% CI 0.342–0.905)
- Clinical over radiographic diagnosis: ratio about 1 (0.778; 95% CI 0.272–1.481)

Authors' Conclusion: Delton-sealed teeth had a lower risk than Fuji III-sealed teeth of developing caries, independent of the diagnostic method used.

Critical Appraisal:

- Allocation procedure not truly random
- Several different operators, located in different clinics

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth with Delton or equivalent resin, grade E for sealing with glass ionomer cement; score 15/16

Citation: Beiruti N, Frencken JE, van't Hof MA, Taifour D, van Palenstein Helderman WH. Caries-preventive effect of a one-time application of composite resin and glass ionomer sealants after 5 years. *Caries Res* 2006; 40(1):52–9.

Population: 103 schoolchildren in Damascus, Syria, with sound pits and fissures or with an early enamel lesion or small dentin lesion in the permanent first molars with no caries in the deciduous dentition.

- Age (mean): 7.8 years
- Sex: 45%/55% distribution for both groups, but breakdown unclear; difference not statistically significant
- Location: Regional World Health Organization Demonstration, Training and Research Centre for Oral Health, Damascus, Syria
- Representative of schoolchildren with low to medium caries risk

Intervention: Light-polymerized composite resin sealant (for 53 children with a total of 180 fully erupted first molars)

Control: High-viscosity glass ionomer (for 50 children with a total of 180 fully erupted first molars)

Outcomes (evaluated annually for 5 years by calibrated examiners):
Sealant retention at 5-year follow-up:

- Composite resin: 14%
- Glass ionomer (GI): 12% (complete loss of sealant: 40% of subjects)

Caries development in pits and fissures after complete loss of sealants and re-exposure (significantly less with GI):
- At 2–3 years (long-term re-exposure):

- Composite resin: 13%
- GI: 3%

- At 0–1 years (short-term re-exposure):

- Composite resin: 3.9%
- GI: 0.8%

Relative risk (RR) (and 95% confidence interval [CI]) of caries development for GI vs. composite resin:

- At 3 years: 0.22 (0.06–0.82)
- At 4 years: 0.32 (0.14–0.73)
- At 5 years: 0.28 (0.13–0.61)

RR (95% CI) of dentinal caries development for GI vs. composite resin:

- At 0–1 years (short-term): 0.13 (0.05–0.33)
- At 1–2 years (mid-term): 0.26 (0.14–0.48)
- At 2–3 years (long-term): 0.25 (0.09–0.68)

RR (95% CI) of caries development (enamel or dentinal) for GI vs. composite resin:

- At 0–1 years (short-term): 0.94 (0.60–1.50)
- At 1–2 years (mid-term): 0.66 (0.54–0.81)
- At 2–3 years (long-term): 0.68 (0.56–0.82)

Authors' Conclusion: The caries-preventive effect of high-viscosity GI sealants, placed using the atraumatic restorative treatment (ART) procedure, was between 3.1 and 4.5 times higher than that of composite resin sealants after 3 to 5 years. Furthermore, high-viscosity (ART) GI sealants appeared to have a 4 times higher chance than light-cured composite resin sealant of preventing caries development in re-exposed pits and fissures of occlusal surfaces in first molars over a 1- to 3-year period.

Critical Appraisal:

- No control for possible confounders: number of brushing sessions, diet, exposure to fluoride, etc.
- Loss to follow-up as high as 48%
- No placebo control

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing retention and preventing caries; score 15/16

Citation: Bravo M, Montero J, Bravo JJ, Baca P, Llodra JC. Sealant and fluoride varnish in caries: a randomized trial. *J Dent Res* 2005; 84(12):1138–43.

Population: 350 children recruited in 1990
Characteristics of children (n = 120) who remained in the study after 9 years:
- Age (mean ± standard deviation): 7.4 ± 0.7 for control group, 7.3 ± 0.8 for sealant group, 7.6 ± 0.7 for fluoride (F) varnish group
- Sex: 51.1% females for control group, 67.6% females for sealant group, 47.4% females for F varnish group
- Location: Granada, Spain (no fluoridation)
- Representative of middle-class children in Granada, Spain

Intervention:
- *n* = 105 children, Delton light-polymerized opaque fissure sealant (Johnson & Johnson Dental Products Co., East Windsor, N.J.) applied to all healthy, permanent, fully erupted first molars; after 6, 12, 18, 24 and 36 months, sealant was applied to newly erupted molars and was replaced if there had been partial or total loss.
- *n* = 110 children, Duraphat fluoride varnish (Colgate-Palmolive Co., New York, N.Y.) was applied to all healthy permanent first molars with partially or fully erupted occlusal surfaces; after 6, 12, 18, 24, 30, 36 and 42 months, varnish was applied to newly erupted molars and was reapplied to all molars that had remained healthy.

Control: *n* = 135 children

Outcomes: Follow-up after 9 years; only those with at least one sound and fully erupted permanent first molar who were examined at both the 4-year and the 9-year follow-up were included for analysis.
- Loss to follow-up: 51% in control group, 52% in sealant group, 55% in F varnish group
- 120 children for analysis at 9-year follow-up (45 in control group, 37 in sealant group and 38 in F varnish group), 371 molars (129 in control group, 113 in sealant group and 129 in varnish group)

No significant differences in sex, age, social level or baseline caries scores between the followed children and the 185 lost to follow-up
No significant difference in the average number of examination visits per child (8.75; standard deviation [SD] 0.55), excluding the 9-year follow-up visit

Average number of treatment visits per child during the active phase of the programs:
- 2.24 (SD 1.14) for sealant group
- 7.26 (SD 0.98) for F varnish group

Occlusal caries at 9 years:
Significant difference between the groups, adjusted for multiple molars within each child and cluster (school classes rather than children) random allocation ($p < 0.001$)
- Control: 76.7%; decayed (D) = 59, missing (M) = 4, filled (F) = 36, filled occlusal surfaces that had been declared sound at the previous visit = 12; D = 17, M = 1, F = 12, filled occlusal surfaces that had been declared sound at the previous visit = 4
- Sealant: 26.6%
- Varnish: 55.8%; D = 40, M = 0, F = 32, filled occlusal surfaces that had been declared sound at the previous visit = 13

Effectiveness of treatments:
- At 4 years: 76.3% (standard error [SE] 7.9%) for sealant vs. control, 43.9% (SE 10.3%) for varnish vs. control, 57.8% (SE 14.7%) for sealant vs. varnish
- At 9 years: 65.4% (SE 8.5%) for sealant vs. control, 27.3% (SE 10.2%) for varnish vs. control, 52.4% (SE 12.2%) for sealant vs. varnish

Sealant retention rate (*n* = 113):
- Complete retention: 44 (38.9%)
- Partial or complete loss: 55 (48.7%)

Authors' Conclusion: The varnish program was not effective during the discontinuation period.

Critical Appraisal:
- Longest follow-up period to date in a study of caries reduction with a third-generation (visible-light-cured) sealant
- 50% loss to follow-up because of children moving to other districts or cities

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for long-term sealing retention and preventing caries; score 14.5/16

Citation: Warren DP, Infante NB, Rice HC, Turner SD, Chan JT. Effect of topical fluoride on retention of pit and fissure sealants. *J Dent Hyg* 2001; 75(1):21–4.

Population: 16 first-year dental hygiene students with virgin molars or premolars, no caries present, no medical contraindications for treatment
- Age: > 18 years
- Sex: Not mentioned
- Location: University of Texas, Houston Health Science Center
- Representative of university students

Intervention: Full-mouth topical fluoride application of 1.23% acidulated phosphate fluoride + Concise Light Cure White Sealant (CLC) and Concise White Sealant System (CSC) in the 2 remaining quadrants

Control: CLC and CSC placed in the 2 nonfluoridated quadrants of each participant

Outcomes: Overall sealant retention at 6, 12 and 18 months: 68%, 48% and 49%, respectively
- Significant difference between fluoridated and nonfluoridated teeth
- More retention on fluoridated teeth, with respect to sealant material (CLC–fluoride)
- Significant differences between CLC–fluoride and CLC–no fluoride treatment groups
- No significant differences in retention between CSC–fluoride and CSC–no fluoride groups, although more partial loss and less total loss
- Overall, no significant differences between CLC and CSC, irrespective of fluoridation
- Significantly greater retention on premolars vs. molars
- More retention in the CLC–fluoride group than the CLC–no fluoride group

Authors' Conclusion: Sealant retention may not be adversely affected by a topical fluoride treatment applied immediately before placement.

Critical Appraisal:
- Study of insufficient duration

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade B for use of fluoride therapy before sealing teeth and for sealing retention and preventing caries; score 14.5/16

Citation: Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I, Hebling J. Improved sealant retention with bonding agents: a clinical study of two-bottle and single-bottle systems. *J Dent Res* 2000; 79(11):1850–6.

Population: 165 children with a total of 617 molars (410 first molars and 207 second molars) and a total of 1,058 tooth surfaces (617 being occlusal sealants and 441 buccal–lingual sealants); split-mouth design (half receiving sealant alone and half receiving bonding agent plus sealant)

- Age: 5–19 years
- Sex: Not mentioned
- Location: Pediatric dentistry clinic at the University of Michigan
- Representative of children attending the university dental clinics

Intervention: 1 maxillary and 1 mandibular molar received bonding agent (3 bonding agent groups: Tenure primer, Scotchbond Multi-Purpose and 3 single-bottle dentin bonding agents) plus sealant

Control: Opposite molar in each arch received sealant alone

Outcomes:

- Overall average yearly failure rates: 15%–29% over the 6 cohort–treatment groups
- Caries development for all sealed teeth over 5 years: 12 caries lesions (1.1%)

Hazard ratio (HR) of preventing sealant failure, where HR > 1 means increased risk of failure and HR < 1 means protective effect:

- Single-bottle group vs. control: 0.53 ($p = 0.014$) for occlusal sealants, 0.35 ($p = 0.006$) for buccal–lingual sealants
- Scotchbond vs. control: 2.96 ($p = 0.0003$) for occlusal sealants, no difference for buccal–lingual sealants
- Tenure primer vs. control: 1.0 (neutral)

Significant factors affecting the success between occlusal and buccal–lingual sealants:

- Significant for both: early eruption stage (occlusal HR = 2.91, buccal–lingual HR = 1.52)
- Significant only for occlusal sealants: behaviour (HR = 1.96), salivary problems (HR = 1.73), visually apparent variations in enamel (HR = 1.51)

Authors' Conclusion: Single-bottle bonding agents protect sealant survival, yielding half the usual risk of failure for occlusal sealants and one-third the risk of failure for buccal–lingual sealants.

Critical Appraisal:

- No control over care provided outside of study
- 38% loss to follow-up at 4 and 5 years

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for using single-bottle adhesive systems before sealant placement, grade A for caries-preventive effect of sealant; score 14.5/16

Citation: Yazici AR, Kiremitci A, Celik C, Ozgunaltay G, Dayangac B. A two-year clinical evaluation of pit and fissure sealants placed with and without air abrasion pretreatment in teenagers. *J Am Dent Assoc* 2006; 137(10):1401–5.

Population: Dental school patients with good oral hygiene, no restorations or sealants on fissures, no detectable caries

- Age: 16 and 17 years
- Sex: 14 female, 2 male
- Location: Hacettepe University Dental School, Ankara, Turkey
- Representative of teenagers, dental school patients

Intervention: 16 subjects, with a total of 162 teeth (46 molars, 116 premolars)
Group I: Fissure preparation with phosphoric acid gel on randomly assigned maxillary and mandibular permanent premolars and molars from one side of the mouth

Control: Group II: Air abrasion followed by acid etching on the contralateral side of the mouth

Outcomes: n = 162 teeth, recall at 6, 12 and 24 months
Retention rate:

- At 6 months, no statistically significant difference between groups
- At 12 months, higher retention rate in group II than group I (95.1% vs. 84%, $p = 0.025$)
- At 24 months, higher retention rate in group II than group I (91.4% vs. 76.5%, $p = 0.002$)
- Total sealant loss: group II, none; group I, 7 sealants (8.6%) at the 24-month recall appointment
- Complete or partial retention rates of premolars statistically higher than those for molars in both groups

Caries development:

- 0 sealed surfaces throughout the 24-month recall period in both groups

Authors' Conclusion: Given that air abrasion followed by acid etching resulted in significantly higher sealant retention rates, this method could be a good choice for fissure preparation before sealant placement for long-term success.

Critical Appraisal:

- Use of rubber dam for isolation is noted
- No mention of ethics approval
- No placebo control

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for using air abrasion before sealant for improving the retention rate, grade A for sealing teeth to prevent caries development; score 14/16

Citation: Pereira AC, Pardi V, Mialhe FL, Meneghim Mde C, Ambrosano GM. A 3-year clinical evaluation of glass-ionomer cements used as fissure sealants. *Am J Dent* 2003; 16(1):23–7.

Population: 208 schoolchildren from low-income area with all permanent molars sound and sealed living in Piracicaba (0.7 ppm fluoride in water), São Paulo, Brazil, for the 2 years preceding the study
- Age: 6–8 years of age
- Sex: Not mentioned
- Location: Department of community dentistry, School of Dentistry, University of Campinas, Piracicaba, São Paulo, Brazil
- Representative of low-income schoolchildren 6–8 years of age

Intervention: 100 children with a total of 400 permanent first molars received conventional glass ionomer sealants (Ketac Bond; $n = 200$ teeth) and resin-modified glass ionomer sealants (Vitremer; $n = 200$ teeth)

Control: 200 resin-modified glass ionomer sealants (Vitremer) in 108 children ($n = 432$ teeth)

Outcomes: Sealant retention at 6, 12, 24, and 36 months after sealant application:
- Ketac Bond: 26%, 12%, 3% and 4%, respectively
- Vitremer: 61%, 31%, 14% and 13%, respectively

The differences between the 2 materials were statistically significant.

Caries incidence (experimental groups vs. control group) at 6, 12, 24, and 36 months after sealant application:
- 93%, 78%, 49% and 56% lower, respectively, than control group ($p < 0.01$)

Correlation between previous caries experience and caries incidence after 3 years:
- Experimental group: nonsignificant
- Control group: odds ratio (OR) 4.2, $p < 0.01$

Correlation between active incipient caries and caries incidence after 3 years:
- Ketac-Band, Vitremer, control: OR 4.47, 5.33, 1.77, respectively (all significant)

Authors' Conclusion: The retention rates for ionomeric materials were low. Nevertheless, these materials showed a cariostatic effect, supported by statistically lower caries incidence in experimental groups compared with the control group. Presence of active incipient caries was statistically associated with caries incidence in the first molars after 36 months, in relation to either experimental or control groups.

Critical Appraisal:
- Care outside study was not identified or controlled for.
- It is unethical to withhold a proven caries-preventive therapy.

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing retention and preventing caries, grade E for use of glass ionomer cement as sealant (because of loss rates); score 14/16

Citation: Pinar A, Sepet E, Aren G, Bolukbasi N, Ulukapi H, Turan N. Clinical performance of sealants with and without a bonding agent. *Quintessence Int* 2005; 36(5):355–60.

Population: 30 schoolchildren with all permanent first molars sound and unsealed (*n* =120 teeth)
- Age: 8–10 years
- Sex: Not mentioned
- Location: Pediatric dentistry clinic, faculty of dentistry, University of Istanbul, Istanbul, Turkey
- Representative of schoolchildren with low socioeconomic status and high risk of caries

Intervention: Split-mouth design using 4 molars from each child; *n* = 60 teeth, with 1 maxillary and 1 mandibular molar from each child receiving sealant (Fissurit F, Voco/Cuxhaven) with a bonding agent

Control: *n* = 60 contralateral teeth, which received only sealant (Fissurit F, Voco/Cuxhaven)

Outcomes: Assessed at 3, 6, 12 and 24 months (only data from 12 and 24 months were abstracted)
- At 12-month follow-up, *n* = 48 teeth in each group; total loss to follow-up 20%
- At 24-month follow-up, *n* = 44 teeth in each group; total loss to follow-up 27%

Marginal integrity (clinically acceptable) at 12- and 24-month follow-ups:
- Significant difference in each group relative to baseline
- Nonsignificant difference between experimental groups
- Sealant + bonding agent: 83.3% and 79.5% at 12 and 24 months, respectively
- Sealant only: 81.2% and 77.2% at 12 and 24 months, respectively
- No marginal discoloration at 12- and 24-month follow-ups
- Significant difference in each group relative to baseline
- Nonsignificant difference between experimental groups
- Sealant + bonding agent: 81% and 75% at 12 and 24 months, respectively
- Sealant only: 79% and 72% at 12 and 24 months, respectively

Retention rate at 12- and 24-month follow-ups:
- Significant difference in each group relative to baseline
- Nonsignificant difference between experimental groups
- Sealant + bonding agent: 83% and 79% at 12 and 24 months, respectively
- Sealant only: 81% and 75% at 12 and 24 months, respectively

Authors' Conclusion: At 2 years after application, placement of a bonding agent under sealants did not significantly affect the clinical success of sealants.

Critical Appraisal:
- No placebo control for caries incidence
- No power calculation
- 27% loss to follow-up after 2 years

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for caries protection and retention rate of both techniques for sealing teeth; score 13.5/16

Citation: Pardi V, Pereira AC, Ambrosano GM, Meneghim Mde C. Clinical evaluation of three different materials used as pit and fissure sealant: 24-months results. *J Clin Pediatr Dent* 2005; 29(2):133–7.

Population: 113 children (from 2 public schools) with 356 permanent first molars with no previous filling, sealant or evidence of caries

- Age: 7–8 years
- Sex: Not mentioned
- Location: Piracicaba (0.7 ppm fluoride in water), São Paulo, Brazil
- Representative of schoolchildren 7–8 years of age with high risk of caries

Intervention: Each child received one of the following sealing materials

- *n* = 117 teeth, resin-modified glass ionomer cement (Vitremer, 3M ESPE, St. Paul, Minn.)
- *n* = 119 teeth, flowable resin composite (Revolution, Kerr Corporation, Orange, Calif.)
- *n* = 120 teeth, compomer (Dyract Flow, Dentsply Caulk, Dentsply International Inc., Milford, Del.)

Control: No placebo control; the 3 groups were compared with each other

Outcomes::24-month loss to follow-up: overall retention rate 17% for Vitremer (*n* = 97 remaining), 21% for Revolution (*n* = 93 remaining), 26% for Dyract Flow (*n* = 89 remaining);
Retention rate: better for Revolution, with statistically significant differences occuring only between retention rates for Vitremer and Revolution and between Revolution and Dyract Flow after 2 years

Total retention rate after 6, 12 and 24 months:

- Vitremer: 97.4%, 77.4% and 47.4%, respectively
- Revolution: 96.3%, 84.4% and 76.3%, respectively
- Dyract Flow: 89.4%, 75.7% and 58.4%, respectively

Small partial retention rate (2/3 of extension present) after 6, 12 and 24 months:

- Vitremer: 0.9%, 12.3% and 20.6%, respectively
- Revolution: 3.7%, 11.9% and 15.1%, respectively
- Dyract Flow: 15.3%, 21.3% and 5.3%, respectively

Large partial retention rate (1/3 of extension present) after 6, 12 and 24 months:

- Vitremer: 1.8%, 4.7% and 16.5%, respectively
- Revolution: 0.0%, 1.8% and 2.2%, respectively
- Dyract Flow: 5.3%, 7.2% and 6.7%, respectively

Total loss rate after 6, 12 and 24 months:

- Vitremer: 0.0%, 5.7% and 15.5%, respectively
- Revolution: 0.0%, 0.9% and 6.5%, respectively
- Dyract Flow: 0.0%, 1.8% and 13.5%, respectively

Caries development (carious/filled) at 12 and 24 months:

- Nonsignificant difference
- Vitremer: 0.9% and 3.1%, respectively
- Revolution: 2.8% and 4.3%, respectively
- Dyract Flow: 2.7% and 6.7%, respectively

No association between caries presence after 2 years and plaque index, deft score and socioeconomic status.

Authors' Conclusion: These results suggest that flowable resin composite had satisfactory retention after this period of evaluation and that all 3 materials were effective in preventing occlusal caries.

Critical Appraisal:

- Loss to follow-up > 20% for Dyract Flow and Revolution
- Blinding unclear
- Care outside the study was not mentioned

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing retention and prevention of caries for all 3 materials; score 13.5/16

Citation: Gungor HC, Altay N, Alpar R. Clinical evaluation of a polyacid-modified resin composite-based fissure sealants: two-year results. *Oper Dent* 2004; 29(3):254–60.

Population: 53 children with a total of 192 fully erupted caries-free permanent first molars living in nonfluoridated area
- Age: 7–10 years
- Sex: 51% female
- Location: Pedodontics clinic, faculty of dentistry, Hacettepe University, Ankara, Turkey
- Representative of schoolchildren with low socioeconomic status and high risk of caries

Intervention: Half-mouth design, random on right and left side of both jaws; *n* = 96 teeth sealed with a polyacid-modified resin-composite-based fissure sealant (Dyract Seal, Dentsply DeTrey, Konstanz, Germany)

Control: *n* = 96 teeth sealed with Delton FS+ resin-based fluoridated fissure sealant (Dentsply International, York, Pa.)

Outcomes: Follow-up at 3, 6, 12 and 24 months (only data from 12 and 24 months were abstracted)
- At 12-month follow-up, *n* = 79 teeth in each group; total loss to follow up 18%
- At 24-month follow-up, *n* = 70 teeth in each group; total loss to follow up 27%

Retention rate (Dyract Seal vs. Delton FS+) not statistically significantly different at either follow-up:
At 12-month follow-up:
- Totally present: 91.1% vs. 86.1%
- Partially lost: 8.9% vs. 13.9%
- Totally lost: 0 in both groups

At 24-month follow-up
- Totally present: 80% vs. 71.4%
- Partially lost: 15.7% vs. 15.7%
- Totally lost: 4.3% vs. 12.9%

Caries development (Dyract Seal vs. Delton FS+) not statistically significantly different:
- At 12-month follow-up: 6.3% vs. 11.4%
- At 24-month follow-up: 14.3% vs. 17.1%

Marginal integrity (Dyract Seal vs. Delton FS+) significantly better for Delton FS+ at 12-month evaluation only
At 12-month follow up:
- Excellent margin (no crevice): 65.9% vs. 81.0%
- Acceptable margin (small crevice): 31.6% vs. 17.7%
- Unacceptable margin (large crevice): 2.5% vs. 1.3%

At 24-month follow up:
- Excellent margin (no crevice): 81.4% vs. 70.0%
- Acceptable margin (small crevice): 10.0% vs. 17.1%
- Unacceptable margin (large crevice): 8.6% vs. 12.9%

Authors' Conclusion: The use of Dyract Seal on permanent molars (invasive technique) was clinically comparable to Delton FS+ for the 24-month evaluation period.

Critical Appraisal:
- No placebo control for caries incidence
- No power calculation
- 27% loss to follow-up in 2 years

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for caries protection and retention rate of both materials for sealing teeth; score 13.5/16

Citation: Grande RH, de Lima AC, Rodrigues Filho LE, Witzel MF. Clinical evaluation of an adhesive used as a fissure sealant. *Am J Dent* 2000; 13(4):167–70.

Population: 38 subjects with caries-free premolars and molars, all undergoing orthodontic therapy
- Age: 11–17 years (mean 14 years)
- Sex: 23 females and 15 males
- Location: School of Dentistry, University of São Paulo, Brazil; research environment not mentioned
- Representative of schoolchildren undergoing orthodontic treatment

Intervention:
- Split-mouth design on 171 teeth (124 premolars and 47 molars)
- *n* = 85 teeth, OptiBond, a dual-cure glass-filled adhesive

Control: *n* = 86 teeth, Delton, a self-cured sealant

Outcomes: Follow-up every 3 to 6 months up to 30 months, with an average of 20.6 ± 5.3 months
Loss to follow up: 25%
Failure rate:
- OptiBond: 13%
- Delton: 37%

Time to loss of retention:
- OptiBond: 27.5 ± 0.7 months
- Delton: 22.1 ± 1.1 months

Cox proportional hazards regression model:
- Nonsignificant: age, sex and arch
- Significant: material (OptiBond better than Delton) and type of teeth (premolars about 3 times [95% confidence interval 1.67–5.69] better than molars)

Authors' Conclusion: Statistical analysis based on a stratified Cox proportional hazards regression model indicated that OptiBond had better clinical performance than Delton.

Critical Appraisal:
- No data on caries incidence
- No follow-up of failures for caries development
- 25% loss to follow-up
- Insufficient duration (< 2 years)
- Retention on premolars 3 times retention on molars

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth with OptiBond sealing retention; score 13.5/16

Citation: de Luca-Fraga LR, Pimenta LA. Clinical evaluation of glass-ionomer/resin-based hybrid materials used as pit and fissure sealants. *Quintessence Int* 2001; 32(6):463–8.

Population: Children with caries-free mandibular first permanent molars
- Age: 7–8 years
- Sex: Not mentioned
- Location: School of Dentistry of Nova Friburgo, Rio de Janeiro, Brazil
- Representative of schoolchildren with low socioeconomic status (SES)

Intervention: 100 children received 2 types of sealants, each randomly assigned to either right or left side of mouth:
- Polyacid-modified resin composite (Dyract), followed by application of nail varnish
- Resin-modified glass ionomer sealant (Vitremer), followed by application of nail varnish

Control: 66 children, same age and SES, with no sealing but professional supervision in their school environment

Outcomes (only 12-month recall is presented):
Complete retention (statistically significant difference):
- Dyract: 95.9%
- Vitremer: 85.7%

Caries incidence:
- Test: 1%
- Control: 10%
- Statistically significant protective effect in the test vs. control at 6 months (odds ratio [OR] 18.80, 95% confidence interval [CI] 2.31–152.67) and 12 months (OR 13.43, 95% CI 2.83–63.77)

Authors' Conclusion: The hybrid materials were able to control occlusal caries. Better retention for resin composite modified by polyacids (Dyract) than for resin-modified glass ionomer (Vitremer) sealants

Critical Appraisal:
- No control over care outside the study
- Study duration was short (1 year)
- Unclear whether the groups were similar at baseline regarding oral health (although similar SES was noted)

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth; score 13/16

Citation: Feigal RJ, Quelhas I. Clinical trial of a self-etching adhesive for sealant application: success at 24 months with Prompt L-Pop. *Am J Dent* 2003; 16(4):249–51.

Population: Children with contralateral pairs of newly erupted first or second permanent molars
- Age: 7–13 years (mean 10.5 years)
- Sex: Not mentioned
- Location: Dental school, University of Michigan
- Representative of children with low to moderate caries risk, from a mixed fluoride region

Intervention: Prompt L-Pop, the first self-etching adhesive, as the sole etching and adhesive step before placement of sealant on 31 permanent molars

Control: Sealant placed on 31 permanent molars after etching with phosphoric acid

Outcomes (follow-up at 1, 3, 6, 12, 18 and 24 months):
24-month success with no significant loss of material or need for repair:
- Occlusal sealants: control vs. Prompt L-Pop, 61% vs. 61%
- Buccal–lingual sealants: control vs. Prompt L-Pop, 54% vs. 62%
- No statistically significant difference

Time of placement for sealants:
- Control vs test: 3.1 vs. 1.8 minutes (statistically significant)

Authors' Conclusion: Prompt L-Pop self-etching adhesive is effective in bonding sealant to enamel, and the simplified method dramatically shortens treatment time and treatment complexity.

Critical Appraisal:
- Small sample size
- No indication of caries-preventive effect
- No indication of entry sample size and loss to follow-up

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade C for using Prompt L-Pop before sealant placement other than to save time; score 12/16

Citation: Poulsen S, Beiruti N, Sadat N. A comparison of retention and the effect on caries of fissure sealing with a glass-ionomer and a resin-based sealant. *Community Dent Oral Epidemiol* 2001; 29(4):298–301.

Population: 179 children at high risk of caries, with at least one pair of permanent first molars that were caries free or only had incipient lesions.

- Age: 7 years old at start of study
- Sex: Not mentioned
- Location: World Health Organization Regional Demonstration, Training and Research Centre for Oral Health, Damascus, Syrian Arab Republic
- Representative of: high-risk children

Intervention: *n* = 179 children, glass ionomer developed for fissure sealing (Fuji III)

Control: Split-mouth design using contralateral teeth in the same children; chemically polymerized resin-based fissure sealant (Delton)

Outcomes: Retention and caries-preventive effect of sealant
Follow-up sample size: 129 after 6 months, 121 after 1 year, 115 after 2 years, 116 after 3 years

At 3-year follow-up:

- Glass ionomer sealant was completely lost from almost 90% of teeth compared to complete loss from less than 10% of resin-sealed teeth.
- Relative risk for tooth sealed with glass ionomer over that for tooth sealed with resin was 3.38 (95% confidence interval 1.98–5.79)
- Relative risk lower for maxillary than mandibular permanent first molars (not significant)

Authors' Conclusion: The glass ionomer sealant had poorer retention and less caries-protective effect than the resin-based sealant.

Critical Appraisal:

- Care outside study was not identified or controlled for.
- No control for possible confounders: number of brushing sessions, diet, exposure to fluoride, active treatment, etc.
- Loss to follow-up high (27%–35%) in first 6 months
- No placebo control
- Difficult to assess caries prevention comparisons when so many in one group (intervention) lost sealants
- Examiner blinding unclear

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth with resin, grade E for use of GI; score 11.5/16

Citation: Florio FM, Pereira AC, Meneghim Mde C, Ramacciato JC. Evaluation of non-invasive treatment applied to occlusal surfaces. *ASDC J Dent Child* 2001; 68(5-6):326–31, 301.

Population: 34 Brazilian preschool children of low socioeconomic status (SES), from 4 different public day nursery schools, with at least 2 permanent first molars with restricted enamel decay (total of 108 teeth) (selected from among 250 children assessed)

- Age: 6 years ± 6 months
- Sex: Not mentioned
- Location: University of Campinas, Piracicaba School of Dentistry, Piracicaba, São Paulo, Brazil
- Representative of children with low SES

Intervention: Initially all had all necessary treatment.

- Group 1, *n* = 12 children with 35 teeth: fissure sealants with resin-modified glass ionomer (Vitremer)
- Group 2, *n* = 11 children with 36 teeth: 2.26% fluoride varnish (Duraphat)

Control: *n* =11 children with 37 teeth: tooth-brushing and weekly mouthwashing with 0.2% sodium fluoride

Outcomes:

- Loss to follow-up: 6 teeth from group 1 and 4 teeth from control group
- Four clinical evaluations carried out over 3, 6, 9 and 12 months

Arrestment of caries activity at 12-month follow-up:

- Group 1 : 100%
- Group 2: 83.3%
- Control: 72.7%

Caries progression at 12-month follow-up (no significant difference):

- Group 1: 0%
- Group 2: 5.5%
- Control: 6.1%

Better inactivation property in group 1 than the other groups ($p < 0.05$).

Authors' Conclusion: These noninvasive methods were able to arrest the progression of occlusal caries, but fissure sealant showed better results in controlling caries activity.

Critical Appraisal:

- No multivariate analysis
- No control over care outside the study
- Blinding of examiners was unclear
- Unclear whether the groups were similar at the start of the trial

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth; score 11/16

Citation: Hamilton JC, Dennison JB, Stoffers KW, Welch KB. A clinical evaluation of air-abrasion treatment of questionable carious lesions. A 12-month report. *J Am Dent Assoc* 2001; 132(6):762–9.

Population: 93 dental patients in a projected 5-year randomized clinical trial, with a total of 223 teeth, each with a questionable incipient pit-and-fissure carious lesion but no frank caries (softness at the base of a pit or fissure, decalcification or cavitation) or evidence of radiographic caries

- Age: 12–36 years (mean 23 years at baseline)
- Sex: Not mentioned
- Location: General dentistry clinics at University of Michigan School of Dentistry
- Representative of dental school patients with lower socioeconomic status

Intervention: n = 113 teeth, air abrasion and restoration with a flowable resin-based composite

Control: n = 110 teeth, observation but no treatment until definition of caries was met

Outcomes: Recall every 6 months (no results provided for 6-month follow-up)

Test group (at baseline: n = 63 treated with sealant, n = 50 caries extending into dentin) at 12-month follow-up:

- 3 sealants (4%) with partial loss
- Retreatment of restoration: 2 teeth (4%)

Control group at 12-month follow-up (n = 86):

- Caries progression: 9 (11%, 95% confidence interval 4–18%) teeth were diagnosed with pit-and-fissure caries and were treated with air abrasion and restored with flowable resin-based composite.
- No statistically significant difference between volume of treatment and control preparations (weight of treatment preparation impression as a surrogate measure of volume: 0.027 g in test group vs. 0.020 g in control group; p = 0.279)
- Control group had significantly fewer carious lesions diagnosed than were determined by operating on the treatment group

Logistic regression (controlling for sex; age; fluoride history; tooth type; decayed, missing or filled surfaces; score on the Löe and Silness Gingival Health Index; score on the Simplified Oral Hygiene Index; pit and fissure colour; explorer retention of the pits and fissures):

Caries penetrating into dentin:

- Positively correlated with explorer retention (p = 0.006)
- Negatively correlated with age (p = 0.0313)

Authors' Conclusion: The merit of treating questionable incipient pit-and-fissure carious lesions early with air abrasion was not demonstrated after 12 months in this clinical study.

Critical Appraisal:

- Study duration was short (12-month report)
- Care outside study was not identified or controlled for

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade E for treating questionable incipient pit-and-fissure carious lesions early with air abrasion; score 10.5/16

Citation: Autio-Gold JT. Clinical evaluation of a medium-filled flowable restorative material as a pit and fissure sealant. *Oper Dent* 2002; 27(4):325–9.

Population: 32 children with 118 fully erupted, caries-free first and/or second permanent molars
- Age: 6–11 years
- Sex: Not mentioned
- Location: University of Florida dental school
- Representative of dental school pediatric patients

Intervention: Half-mouth design
n = 59 teeth, medium-filled (46% volume) flowable restorative material (CuRay-Match, OMNII Oral Pharmaceuticals, West Palm Beach, Fla.)

Control: *n* = 59 teeth, unfilled sealant (Delton, Dentsply Caulk, Milford, Del.)

Outcomes: Only 18-month results are presented here (*n* = 45 teeth in each group); 23% loss to follow-up

Full retention:
- Medium-filled resin vs. unfilled sealant: 40% vs. 64.4% (not significant)

Caries development:
- Medium-filled resin vs. unfilled sealant: 9% vs. 11% (not significant)

Authors' Conclusion: Medium-filled flowable restorative material did not perform better in terms of retention rate or caries increment compared with unfilled conventional sealant.

Critical Appraisal:
- No power calculation
- 23% loss to follow-up
- Insufficient duration
- Operator/evaluator blinding is unclear

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth; score 10/16

Citation: Holmgren CJ, Lo EC, Hu D, Wan H. ART restorations and sealants placed in Chinese school children — results after three years. *Community Dent Oral Epidemiol* 2000; 28(4):314–20.

Population: Children in a school environment
- Age (mean): 12.5 years ± 0.6
- Sex: Not mentioned
- Location: Deyang, Sichuan Province, western China
- Representative of schoolchildren

Intervention: 294 atraumatic restorative treatment (ART) restorations (high-strength glass ionomer [Ketac-Molar, ESPE]) in 197 children; of interest for the current study: 191 fissure sealants in 140 children; retention of sealants was evaluated 3 months after placement and annually for 3 years after placement

Control: None

Outcomes: Numbers of sealants evaluated were 187, 183, 184 and 178 (out of 191) for the 3-month and year 1, year 2 and year 3 examinations, respectively.

Sealant retention (only this outcome was abstracted):
- At 3 months: 97%
- At 3 years: 72% of sealants were either partially or completely retained

Incidence of fissure caries:
- None in the first year
- Only one tooth in the second year of follow-up
- Only 2% of the sealed teeth developed fissure caries, and these involved teeth where the sealants had been lost

Overall, 98% of the sealed occlusal surfaces remained caries-free after 3 years.

Authors' Conclusion: The ART approach for preventing and treating tooth decay in Chinese schoolchildren was appropriate, effective and acceptable. The 3-year survival rates of the restorations were high but were related to the size and type of the restoration.

Critical Appraisal:
- No randomization
- No control group
- No control for possible confounders: number of brushing sessions, diet, exposure to fluoride, etc.

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level II-1; grade A for sealing teeth; score 14/16

Citation: Staninec M, Artiga N, Gansky SA, Marshall GW, Eakle S. Bonded amalgam sealants and adhesive resin sealants: five-year clinical results. *Quintessence Int* 2004; 35(5):351–7.

Population: 26 patients needing at least 2 sealants on permanent posterior teeth (total of 116 teeth)
- Age: 6–25 years
- Sex: Not mentioned
- Location: University of California in San Francisco; research environment unclear
- Representative of patients 6–25 years of age

Intervention:
- n = 37, molar amalgam sealant
- n = 20, premolar amalgam sealant

Control:
- n = 36, molar resin sealant
- n = 23, premolar resin sealant

Outcomes: Clinical examinations at 6 months, 1 year, 2 years and 5 years
- 42% loss to follow-up for patients (n = 15) at 5-year recall
- 16% loss to follow-up for teeth (n = 97)

No difference in retention for amalgam sealants (n = 47) vs. resin sealants (n = 48)
- No loss: 26% vs. 30%, respectively
- Slight loss: 34% vs. 32%, respectively
- Repair required: 40% vs. 38%, respectively

Failure rate for amalgam vs. resin sealants:
- Repair required or total loss: odds ratio (OR) 1.15 (95% confidence interval [CI] 0.65–2.05, p = 0.62)
- Worst category: OR 1.16 (95% CI 0.77–1.75; p = 0.47)
- Hazard ratio for time to "repair required or total loss" 0.81 (95% CI 0.33–2.02; p = 0.65)

Failure rate (molar vs. premolar):
- Resealing OR 4.9 (p = 0.04)
- Worst rating OR 5.6 (p = 0.02)
- Hazard ratio 6.8 (p = 0.004)

Caries development: none on any surface in either group

Authors' Conclusion: Although amalgam sealants may not be practical by themselves, they can be used to seal pits and fissures surrounding very conservative preparations, in the "preventive amalgam restoration." Conventional amalgam retentive features and 90° cavosurface margins may not be necessary when bonding is used with amalgam.

Critical Appraisal:
- Amalgam sealants cost more than resin sealants
- No randomization or placebo group
- 42% loss to follow-up for subjects
- No power calculation
- No blinding of examiners
- Mixed population (6–25 years of age)

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level II-1; grade A for sealing teeth with amalgam sealants or resin-based sealants; score 11/16

Citation: Yildiz E, Dorter C, Efes B, Koray F. A comparative study of two fissure sealants: a 2-year clinical follow-up. *J Oral Rehabil* 2004; 31(10):979–84.

Population: 59 dental students
- Age: 18–20 years
- Sex: Not mentioned
- Location: Department of operative dentistry, faculty of dentistry, Istanbul University, Capa, Istanbul, Turkey
- Representative of young adult population

Intervention: 122 fissures of first and second molars in 59 adults; fluoride-containing fissure sealants (Helioseal F) compared with conventional sealant (Concise Light Cure White Sealant) on first and second molars of right side of patient's mouth (teeth 17, 16, 46 and 47)

Control: 122 fissures of first and second molars in 59 adults: contralateral teeth on left side of each patient's mouth used as controls (teeth 27, 26 36 and 37)

Outcomes: Recall appointments scheduled at 3, 6, 12 and 24 months after placement.
Retention:
- Full retention: 72.1% after 3 months, 46.7% after 24 months (nonsignificant)
- Total loss of Helioseal F (16.4%, 19.7%, 18% and 23% at 3, 6, 12 and 24 months, respectively) was more than total loss of Concise Light Cure White Sealant (8.2%, 9.8%, 11.5% and 18%, respectively) (nonsignificant difference between sealant materials for fully retained, partially lost and totally lost at any recall interval
- Better retention on first molars than on second molars (statistically significant difference at 3, 6 and 12 months; nonsignificant at 24 months)
- Better retention on the mandibular molars (nonsignificant)

Caries development:
- No caries detected at 3 and 6 months in any sealed tooth
- Incidence of caries in teeth treated with Helioseal F vs. Concise Light Cure White Sealant was 11.5% vs. 0% at both 12-month and 24-month recalls (statistically significant)
- Among teeth treated with Helioseal F, caries incidence for upper second molar was higher than for lower first molar teeth (statistically significant at both 12 and 24 months)
- Sealed vs. nonsealed teeth at 12-months: 5.7% vs. 15.6% (statistically significant)
- At 24 months, no change in the sealant group (5.7%), but a statistically significant increase in the control group (from 15.6% to 25.4%)
- Highest caries incidence at 24 months: lower and upper second molar teeth among the unsealed control teeth (nonsignificant)

Authors' Conclusion: Based on the results of this study, the application of fissure sealants is highly effective in preventing caries in a young adult population, and the reduction of caries development is more related to the quality of sealant retention than to the content of the material.

Critical Appraisal:
- No blinding of examiners
- No randomization (split-mouth model)
- Care outside study was not identified or controlled for
- No control for possible confounders: number of brushing sessions, diet, exposure to fluoride, etc.

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level II-1; grade A for sealing teeth; score 11/16

Citation: Morgan MV, Adams GG, Campain AC, Wright FA. Assessing sealant retention using a Poisson frailty model. *Community Dent Health* 2005; 22(4):237–45.

Population: School-based comprehensive preventive program
- Age (mean): 12.35 ± 0.64
- Sex: 48.6% male
- Location: 2 nonfluoridated regions of Victoria, Australia
- Representative of at-risk schoolchildren

Intervention: Annual application or reapplication of light-cured fissure sealants in 210 12-year-old subjects over 3 years:
- *n* = 1,544 sealants during the study period
- *n* = 1,038 (67.2%) first placements at baseline
- *n* = 506 (32.8%) repairs or reapplications, of which 206 (40.7%) at first-year follow-up and 300 (59.3%) at second-year follow-up

Control: None

Outcomes: Sealant failure and caries experience for *n* = 1,038 first placements at baseline:
At first follow-up, *n* = 984 sealants available for review (54 sealants in 10 subjects were lost to follow-up):
- Intact: 582 (59.1%)
- Failed (partial or total loss): 402 (40.9%) (136 never replaced, 60 not replaced until the second year)

At second follow-up, *n* = 739 out of 788 sealants at risk (49 sealants in 22 subjects were lost to follow up):
- Intact: 449 (60.8%)
- Failed: 290 (39.2%) (replacement done)

At third follow-up: *n* = 735 out of 749 sealants at risk (4 sealants in 2 subjects were lost to follow-up):
- Failed: 128 (17.2%)

For total *n* = 1,544 sealant placements and replacements over 3 years:
- Loss to follow-up: 107 (6.9%)
- Failure: 820 (57.1%) at some stage in 3 years
  - At sites with no previous failure: 603 (73.4%)
  - At sites with 1 previous failure: 186 (22.7%)
  - At sites with 2 previous failures: 31 (3.8%)

Caries experience: 51 (6.2%) of all failures: 23 with active decay, 1 extracted, 27 restored

For subjects (baseline *n* = 210; third-year follow-up *n* = 176):
n = 166 (94.3%) with at least one sealant failure
Total of 820 sealant failures by the completion of the program, representing a sealant failure rate of 35%
Success rate at year 3: 575 intact sealants out of 1,038 sealed sites = 55.4%
Of 674 teeth that needed resealing, only 624 were resealed

Significant failure rate ratio (95% confidence interval) for factors associated with sealant failure:
- Baseline pit and fissure DMFS ≥ 4 vs. 0 = 1.27 (1.01–1.61)
- Year of placement 2 vs. 1 = 0.62 (0.44–0.87)
- Second vs. first molars = 1.32 (1.11–1.60)
- Lower vs. upper molars = 1.33 (1.14–1.57)
- Upper distal fossae vs. upper mesial fossae = 1.33 (1.21–1.47)

Adjustment for year of replacement and baseline pit and fissure DMFS:
- No significant interaction between molar and arch type when model was adjusted for

- Significant interaction between molar and sealant placement site (distal vs. mesial fossae) in the upper molars

Authors' Conclusion: Sealants placed on second molars, those placed on lower molars and those placed on the distal fissure sites have a higher failure rate. As individual tooth sites in the mouth are not independent, any statistical analysis should allow for these associations when sealant retention is assessed.

Critical Appraisal:
- Not a strong design to evaluate efficacy
- No randomization
- No blinding
- Not clear if the groups were similar at baseline
- No mention of control over private dental care

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level II-1; grade D for sealing teeth (because of the high loss rate); score 10/16

Citation: Pardi V, Pereira AC, Mialhe FL, Meneghim Mde C, Ambrosano GM. A 5-year evaluation of two glass-ionomer cements used as fissure sealants. *Community Dent Oral Epidemiol* 2003; 31(5):386–91.

Population: Children 6–8 years of age with 4 permanent first molars, no previous filling or clinical evidence of caries, who had lived in Piracicaba (0.7 ppm fluoride [F]), São Paulo, Brazil, since the age of 2 years, selected from a dental assistance program at the University of Campinas in Piracicaba, São Paulo, Brazil

- Age and sex: 6–8 years at start of study; at 5-year follow-up experimental group had 43% boys and 57% girls with mean age of 10 years and 11 months, and the control group had 56% boys and 44% girls with mean age of 11 years and 11 months
- Location: Department of community dentistry, School of Dentistry, University of Campinas, Piracicaba, São Paulo, Brazil
- Representative of healthy young children in a dental assistance program and resident continuously since 2 years of age in a community with stable fluoridation

Intervention: 100 children with a total of 400 permanent first molars

- Material A: resin-modified glass ionomer cement (RMGI, Vitremer 3M ESPE, St. Paul, Minn.)
- Material B: conventional glass ionomer cement (Ketac-Bond 3M ESPE)

Every child received both materials as sealants, according to standardized procedures whereby right-side molars were sealed with material A and left-side molars were sealed with material B.

Control: 108 children with a total of 432 permanent first molars, who received no sealant and reinforcement of brushing technique

Outcomes:

Definitions of sealant retention:

- Total retention (TR) = total retention of sealant on the occlusal surface
- Partial retention type 1 (PR1) = presence of sealant in two-thirds of the pit extension, with small fractures and losses of material
- Partial retention type 2 (PR2) = presence of sealant in one-third of the pit extension with fractures and losses of material
- Total loss (TL) = absence of sealant on the occlusal surface of the teeth

Caries incidence:

- No visible caries and noncavitated lesions
- Presence of microcavity (diameter ≤ 1.5 mm across fissure) and large cavities
- Filled teeth

Total retention rates at 3, 4 and 5 years of follow-up were 24.1%, 12.8% and 1.6%, respectively, for material A; 3.5%, 4.1% and 1.6%, respectively, for material B; difference was significant ($p < 0.01$) in all evaluations for TR, PR1, PR2 and TL.

After 2, 3 and 5 years for carious + filled teeth (statistically higher in control than experimental groups):

- Experimental group: 12.0%, 13.6% and 21.5% (2.0% were carious and 19.5% were filled), respectively
- Control group: 23.7%, 31.2% and 34.2% (9.5% were carious and 24.7% were filled), respectively

Authors' Conclusion: Sealing pits and fissures with glass ionomer cements was effective in preventing caries.

Critical Appraisal:

- No blinding of examiners
- No randomization
- Unclear whether the groups were similar at baseline
- Care outside study was not identified or controlled for
- No control for possible confounders: number of brushing session, diet, etc.
- Half-mouth model but no crossover, so the same material was always on right teeth, which get less oral health care

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level II-1; grade A for sealing teeth; score 10/16

Appendix 2 Efficacy of pit and fissure sealants for primary teeth: included studies

Citation: Corona SA, Borsatto MC, Garcia L, Ramos RP, Palma-Dibb RG. Randomized, controlled trial comparing the retention of a flowable restorative system with a conventional sealant: one-year follow up. *Int J Paediatr Dent* 2005; 15(1):44–50.

Population: 40 children with 160 sound, caries-free, fully erupted first or second primary molars and first permanent molars with deep and retentive pits and fissures

- Age: 4 and 7 years
- Sex: Not mentioned
- Location: Public Health Service in Marília (São Paulo State, São Paulo, Brazil)
- Representative of preschool children seeking routine dental care in the public sector

Intervention: Split-mouth design
For both primary and permanent dentition, half of the teeth on one side of the mouth (n = 40 in each group) were sealed with flowable restorative system (Bond 1 + Flow-It!)

Control: For both primary and permanent dentitions, half the teeth on the contralateral side (n = 40 in each group) were sealed with conventional filled resin sealant (Fluroshield)

Outcomes (6- and 12-month follow-up):
Retention rate:

- Total loss at 1-year follow-up: 0 for both materials, both dentitions
- Higher retention rate for Flow-It! sealants at both 6-month and 1-year evaluations (significant difference for primary teeth, trend for permanent teeth

Primary teeth, Flow-It! vs. Fluroshield:
Total retention (significant difference):

- At 6 months: 97.5% vs. 82.5%
- At 12 months: 95% vs. 77.5%

Partial retention (significant difference):

- At 6 months: 2.5% vs. 17.5%
- At 12 months: 5% vs. 22.5%

Permanent teeth, Flow-It! vs. Fluroshield:
Total retention (nonsignificant difference):

- At 6 months: 100% for both materials
- At 12 months: 100% vs. 95%

Partial retention (significant difference):

- At 6 months: 0 for both materials
- At 12 months: 0 vs. 5%

Statistically significant difference between baseline and other evaluation periods when the sealant results were combined.

Authors' Conclusion: Flowable restorative system yielded optimal retention for both primary and permanent molars. Its retention rate was significantly higher than that of the conventional pit-and-fissure sealant on primary teeth.

Critical Appraisal:

- Blinding of examiner unclear
- Insufficient study duration
- No result on caries-preventive effect of the materials

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing primary teeth with Bond 1 + Flow-It! and for preventing caries, grade A for retention rate of both materials when sealing permanent teeth; score 13/16

Citation: Chadwick BL, Treasure ET, Playle RA. A randomised controlled trial to determine the effectiveness of glass ionomer sealants in pre-school children. *Caries Res* 2005; 39(1):34–40.

Population: 508 preschool children at high risk of dental caries with caries-free first primary molars
- Age: 18–30 months; mean age in the test group: 2.03 years and mean age in the control group: 2.02 years; no difference in age at baseline or follow-up
- Sex: 51%/49% ratio of females to males in each test group and in overall group
- Location: High-caries areas of South Wales, U.K.
- Representative of high-risk preschool children

Intervention: *n* = 241, first primary molars sealed with glass ionomer

Control: *n* = 267, with no sealant

Outcomes:
Prevalence of deft = 0 (no significant difference at baseline or follow-up):
- Baseline: 99.6% and 95.5% in test and control groups, respectively
- At follow-up: 76.5% and 75.9% in test and control groups, respectively

Sealant retention at follow-up:
- From *n* = 221 children in test group, 31.2% of children and 18.7% of molars retained sealant

Frequency of occlusal caries on first primary molars at follow-up:
- Nonsignificant difference between the 2 groups: 2.8% CI (-2.6 to 8.3%)
- No difference in number of lesions between the 2 groups

Caries prevalence:
- No significant difference between the 2 groups for whole-mouth deft/defs or incidence of caries on either first or second molars separately

Authors' Conclusion: There is no evidence that the intervention used in this population had any effect on caries incidence, and it cannot be recommended as a clinical procedure.

Critical Appraisal:
- No clear criteria for outcome evaluation
- Insufficient duration of follow-up
- Blinding of examiners unclear

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade D for sealing primary teeth; score 10/16

Citation: Rajic Z, Gvozdanovic Z, Rajic-Mestrovic S, Bagic I. Preventive sealing of dental fissures with Heliosil: a two-year follow-up. *Coll Antropol* 2000; 24(1):151–5.

Population: Primary and permanent teeth of 300 children with healthy parallel teeth
- Age: 6–7 years
- Sex: Not mentioned
- Location: Zagreb, Croatia; practice setting unclear
- Representative of school children 6–7 years of age with healthy teeth

Intervention: Fissure sealing performed on one side (n = 46 pairs of primary teeth, n = 56 pairs of permanent teeth)

Control: Contralateral teeth in the same subjects

Outcomes: Examinations every 6 months for a 2-year period

Sealant retention after 2 years:
- Primary teeth: 92% for upper teeth, 100% for lower molars
- Permanent teeth: 79% for upper teeth, 97% for lower teeth

Caries development: no caries development in fully retained sealants of both primary and permanent teeth

Primary teeth:
- Sealant missing: 5% at 18 months and 8% at 24 months
- No caries in treated group vs. 31% of the control group

Permanent teeth:
- Sealant missing: 18% of sealed teeth at 24 months vs. 59% of control

Authors' Conclusion: The authors of this study recommended that a procedure of sealing permanent first molars should be proclaimed as a precondition for enrolling in the first grade of primary school for all children in Croatia. The life of a sealant is 5 years, whereas the life of amalgam is 10 years, so 2 sealants cost less than 1 amalgam.

Critical Appraisal:
- Descriptive analysis only
- No criteria for placement of sealant or evaluation of outcome are mentioned
- No control over care outside the study
- No control over possible confounders
- No indication of study setting or type of operator/examiner
- 20% loss to follow-up
- Blinding of examiner not mentioned

Level of Evidence, Grade of Recommendation and Score on "Checklist to Assess Evidence of Efficacy of Therapy or Prevention": Level I; grade A for sealing teeth; score 10/16

Appendix 3 Efficacy of pit and fissure sealants: techniques and materials used

Citation: Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I, Hebling J. Improved sealant retention with bonding agents: a clinical study of two-bottle and single-bottle systems. *J Dent Res* 2000; 79(11):1850–6.

Material: Fluoroshield sealant (Dentsply/Caulk, Milford, Del.)

Various bonding agents before sealant placement:
- Tenure primer (Den-Mat, Santa Maria, Calif.)
- Scotchbond Multipurpose primer (3M Dental Products Division, St. Paul, Minn.)
- Both of the preceding are components of fourth-generation (2-bottle) dentin-bonding systems that have individual component bottles for the primer and the adhesive portion of the bonding agent
- Prime & Bond (Dentsply/Caulk), the newer fifth-generation (one-bottle) dentin-bonding system

Selection of Teeth and Tooth Type or Morphology: Newly erupted permanent first molars

Technique:
1. Slow-speed dry-brush cleaning of the surface
2. Cotton roll isolation
3. 30 seconds phosphoric acid gel etching
4. 15 seconds rinse and air-dry
5. Placement of bonding agent with a hand-held brush, air-thinned across the surface
6. Application of sealant
7. 40 seconds light-curing of sealant and bonding agent together

Citation: Yazici AR, Kiremitci A, Celik C, Ozgunaltay G, Dayangac B. A two-year clinical evaluation of pit and fissure sealants placed with and without air abrasion pretreatment in teenagers. *J Am Dent Assoc* 2006; 137(10):1401–5.

Material: Concise Light Cure White Sealant (3M ESPE, St. Paul, Minn.), an unfilled sealant, with a filler weight of 9.9%

Selection of Teeth and Tooth Type or Morphology: Maxillary and mandibular permanent premolars and molars

Technique:
1. Clean tooth with pumice and water slurry using a slow-speed handpiece for 30 seconds.
2. Wash the tooth with a water spray for 60 seconds.
3. For group I, etch occlusal fissures with 35% phosphoric acid gel for 30 seconds using a microbrush.
4. Rinse enamel with water for 30 seconds, then dry enamel for 15 seconds with oil-free compressed air.
5. For group II, abrade occlusal fissures with an air abrasion device (PrepStart, Danville Materials, San Ramon, Calif.) with 27-µm aluminum oxide particles at pressure of 120 pounds per square inch (nozzle tip perpendicular to the surface, at a distance of 2–3 mm).
6. Rinse teeth with a water spray for 30 seconds to clean residual aluminum particles from the surface.
7. Etch prepared occlusal fissures with 35% phosphoric acid gel for 30 seconds.
8. Thoroughly rinse and dry (similar to group I).
9. Apply Concise Light Cure White Sealant to prepared surfaces using a microbrush and an explorer.
10. Apply 40 seconds of light-curing with a power output of 400 mW/cm^2.
11. Remove rubber dam, check occlusion, adjust sealants with a composite finishing bur, and polish sealants with polishing points.

Citation: Pinar A, Sepet E, Aren G, Bolukbasi N, Ulukapi H, Turan N. Clinical performance of sealants with and without a bonding agent. *Quintessence Int* 2005; 36(5):355–60.

Material: Fissurit F sealant (Voco/Cuxhaven) with One Coat Bond bonding agent (Coltene/Whaledent)

Selection of Teeth and Tooth Type or Morphology: Permanent first molars

Technique:
1. Clean teeth with a bristle brush rotating on a low-speed handpiece with irrigation.
2. Isolate tooth with cotton rolls.
3. Etch with phosphoric acid gel for 30 seconds.
4. Rinse for 20 seconds and air-dry.
5. Apply One Coat Bond bonding agent with a hand-held brush, and air-thin across the surface.
6. Place Fissurit F sealant and light-cure for 40 seconds.

Citation: Pardi V, Pereira AC, Ambrosano GM, Meneghim Mde C. Clinical evaluation of three different materials used as pit and fissure sealant: 24-months results. *J Clin Pediatr Dent* 2005; 29(2):133–7.

Material:
- Resin-modified glass ionomer cement (Vitremer, 3M ESPE, St. Paul, Minn.)
- Flowable resin composite (Revolution, Kerr Corporation, Orange, Calif.)
- Compomer (Dyract Flow, Dentsply Caulk, Dentsply International Inc., Milford, Del.)

Selection of Teeth and Tooth Type or Morphology: Permanent first molar

Technique:
1. Portable equipment
2. Pumice prophylaxis
3. Rinse
4. Cotton roll isolation
5. Etch with 37% phosphoric acid gel for 15–20 seconds
6. Rinse
7. Substitute cotton rolls
8. Material placement as below
9. Occlusion check

Vitremer: Apply primer (3M ESPE) and light-cure for 20 seconds; mix Vitermer in proportion of 1:2 (powder to liquid) and insert it into the fissures using a dental explorer.

Revolution: Apply and light-cure the filled bonding system (OptiBond Solo, Kerr Corporation).

Dyract Flow: Apply and light-cure the filled bonding system (Prime & Bond NT, Dentsply).

Citation: Gungor HC, Altay N, Alpar R. Clinical evaluation of a polyacid-modified resin composite-based fissure sealant: two-year results. *Oper Dent* 2004; 29(3):254–60.

Material: Dyract Seal (Dentsply DeTrey, Konstanz, Germany) *or* Delton FS+ (Dentsply International York, Pa.)

Selection of Teeth and Tooth Type or Morphology: Fully erupted caries-free permanent first molars

Technique:
1. Clean teeth with a bristle brush rotating on a low-speed handpiece with irrigation.
2. Isolate tooth with cotton rolls.
3. Perform enameloplasty using tapered diamond bur with a very fine tip in a high-speed instrument.
4. Place the material as described below.
5. Perform retention and coverage check.
6. Perform occlusion check.

Dyract Seal:
1. Conditioning: apply Non-Rinse Conditioner (Dentsply DeTrey) to the occlusal surface and leave undisturbed for 20 seconds.
2. Gently air-dry with no rinse.
3. Apply Prime & Bond NT (Dentsply DeTrey) with a disposable brush for 20 seconds.
4. Gently air-dry for 5 seconds.
5. Place Dyract Seal and light-cure for 40 seconds.

Delton FS+
1. Etch with 34% phosphoric acid gel for 30 seconds.
2. Rinse for 15 seconds and air-dry.
3. Place Delton FS+ and light-cure for 40 seconds (use an extra 40 seconds for palatal surface of maxillary molars).

Citation: Grande RH, de Lima AC, Rodrigues Filho LE, Witzel MF. Clinical evaluation of an adhesive used as a fissure sealant. *Am J Dent* 2000; 13(4):167–70.

Material: OptiBond, a dual-cure glass-filled adhesive, and Delton, a self-cured sealant

Selection of Teeth and Tooth Type or Morphology: Caries-free permanent premolars and molars

Technique:
1. Clean teeth with pumice and bristle-brush in the slow-speed handpiece.
2. Isolate tooth with cotton rolls.
3. Using a small cotton pellet, rub 37% phosphoric acid solution for 30 seconds, extending up to the cuspal planes.
4. Rinse and dry with compressed air.
5. Apply sealant with the aid of a dental student (Delton has its own dispenser)
6. After 1 minute, perform retention test by applying dislodgement forces with an explorer.

Before placement of OptiBond:
1. Apply primer with a microbrush for 30 seconds, then light-cure for 20 seconds.
2. Apply adhesive (3A plus 3B) on the surface using a small dentin curette, then a 15-second delay, then light-cure for 60 seconds.

Citation: Corona SA, Borsatto MC, Garcia L, Ramos RP, Palma-Dibb RG. Randomized, controlled trial comparing the retention of a flowable restorative system with a conventional resin sealant: one-year follow up. *Int J Paediatr Dent* 2005; 15(1):4450.

Material:
- Filled resin-based pit-and-fissure sealant (Fluroshield, Dentsply Caulk, Milford, Del.)
- Single-bottle adhesive system (Bond 1, Jeneric/Pentron, Inc., Wallingford, Conn.) used in association with a flowable resin composite (Flow-It!, Jeneric/Pentron, Inc., Wallingford, Conn.)

Selection of Teeth and Tooth Type or Morphology: Primary and permanent dentitions

Technique:
1. Use rubber dam for isolation.
2. Etch with 37% phosphoric acid gel (Gel Etchant, Kerr Corporation, Orange, Calif.) for 30 seconds.
3. Rinse with air–water spray for 30 seconds.
4. Dry with a mild, oil-free air stream for 20 seconds.

Flowable resin system:
1. Apply 2 coats of Bond 1 single-bottle adhesive to etched surface.
2. Light-cure for 20 seconds.
3. Apply Flow-It! from the central fissure up toward the cusps to prevent voids, air entrapment or bubbles.
4. Light-cure for 40 seconds.
5. Remove rubber dam, and perform occlusion check.

Fluroshield:
1. Using a disposable applicator, apply sealant on etched occlusal pits and fissures from the central fissure up toward the cusps to prevent voids, air entrapment or bubbles.
2. Light-cure for 40 seconds.
3. Remove rubber dam, and perform occlusion check.

Citation : de Luca-Fraga LR, Pimenta LA. Clinical evaluation of glass-ionomer/resin-based hybrid materials used as pit and fissure sealants. *Quintessence Int* 2001; 32(6):463–8.

Material:
- Resin composite modified by polyacids (Dyract), followed by application of nail varnish
- Resin-modified glass ionomer sealant (Vitremer), followed by application of nail varnish

Selection of Teeth and Tooth Type or Morphology: Mandibular first permanent molars

Technique:
1. Prophylaxis with pumice, water, Rubson scrub (KG Sorensen)
2. Cotton roll isolation
3. Etching with 35% phosphoric acid gel for 30 seconds
4. Wash, dry
5. Primer application
6. Sealant placement
7. Light cure for 40 seconds
8. Occlusion check
9. Polishing with Enhance Sharp end (Dentsply)
10. Covering sealants with nail varnish (Colorama) for protection against syneresis and imbibition during the first 24 hours

Citation: Feigal RJ, Quelhas I. Clinical trial of a self-etching adhesive for sealant application: success at 24 months with Prompt L-Pop. *Am J Dent* 2003; 16(4):249–51.

Materials:
- Prompt L-Pop, the first self-etching adhesive, as the sole etching and adhesive step before placement of sealant
- Light-cured Delton sealant (Dentsply) with (n = 31 permanent molars) or without (n = 31 permanent molars) pre-treatment by phosphoric acid etching

Selection of Teeth and Tooth Type or Morphology: Permanent molars

Technique:
Cotton roll isolation, chairside assistant

Control method:
1. 30 seconds phosphoric acid gel etching
2. 15 seconds water rinse
3. Application of sealant (Delton), 40 seconds light-curing

Experimental method:
1. Rubbing Prompt L-Pop etch on the surface for 15 seconds, air-drying the layer
2. Application of sealant (Delton), 40 seconds light-curing

Citation: Florio FM, Pereira AC, Meneghim Mde C, Ramacciato JC. Evaluation of non-invasive treatment applied to occlusal surfaces. *ASDC J Dent Child* 2001; 68(5-6):326–31, 301.

Material: Resin-modified glass ionomer (Vitremer, 3M of Brazil)

Selection of Teeth and Tooth Type or Morphology: Permanent first molars with restricted enamel decay

Technique:
1. Apply appropriate prophylaxis.
2. Etch with 37% phosphoric acid for 30 seconds.
3. Place Vitremer sealant according to manufacturer's instructions, with change in proportion (to 1:2) to obtain a better consistency for flow.

Citation: Hamilton JC, Dennison JB, Stoffers KW, Welch KB. A clinical evaluation of air-abrasion treatment of questionable carious lesions. A 12-month report. *J Am Dent Assoc* 2001; 132(6):762–9.

Material: Tetric Flow (Ivoclar Vivadent), a flowable light-cured composite

Selection of Teeth and Tooth Type or Morphology: Any tooth with a questionable incipient pit-and-fissure carious lesion but no frank caries (softness at the base of a pit or fissure, decalcification or cavitation) or evidence of radiographic caries

Technique:
1. Use rubber dam for isolation.
2. Abrade the questionable pits and fissures using a dental abrasion system and aluminum oxide powder.
3. Etch the preparation and the tooth surface 1 mm beyond the cavosurface margin with 37% phosphoric acid gel.
4. Rinse, then dry.
5. Apply and cure dentin–enamel bonding agent.
6. Place and light-cure the sealant material.
7. Perform occlusion check and adjustment.

Citation: Chadwick BL, Treasure ET, Playle RA. A randomised controlled trial to determine the effectiveness of glass ionomer sealants in pre-school children. *Caries Res* 2005; 39(1):34–40.

Material: Ketac-Fil Plus glass ionomer (hand-mix powder and liquid, shade A1, ESPE)

Selection of Teeth and Tooth Type or Morphology: Lower left first primary molars

Technique:
1. Use cotton rolls for isolation.
2. Clean the surface with cotton wool pellets or rolls dipped in water.
3. Dry.
4. Use explorer to remove debris and plaque from the fissures.
5. Place glass ionomer onto the occlusal surface with a flat plastic carver, slightly overfilling.
6. Coat fingertip with petroleum jelly and press into pits and fissures for a few seconds.
7. Remove excess with flat plastic carver or cotton wool roll coated with petroleum jelly.

Citation: Autio-Gold JT. Clinical evaluation of a medium-filled flowable restorative material as a pit and fissure sealant. *Oper Dent* 2002; 27(4):325–9.

Material:
- n = 59 teeth sealed with unfilled sealant (Delton, Dentsply Caulk, Milford, Del.)
- n = 59 teeth sealed with flowable restorative material (CuRay-Match, OMNII Oral Pharmaceuticals, West Palm Beach, Fla.)

Selection of Teeth and Tooth Type or Morphology: Fully erupted, caries-free first and/or second permanent molars

Technique:
1. Use cotton rolls for isolation.
2. Etch with 37% phosphoric acid for 20 seconds.
3. Rinse for 15 seconds and dry for a few seconds.
4. Place sealant and light-cure for 40 seconds.

Citation: Holmgren CJ, Lo EC, Hu D, Wan H. ART restorations and sealants placed in Chinese school children — results after three years. *Community Dent Oral Epidemiol* 2000; 28(4):314–20.

Material: Ketac-MolarA (ESPE Dental Medizin, Germany), a hand-mixed, high-strength glass ionomer

Selection of Teeth and Tooth Type or Morphology: Permanent molars

Technique:
1. Use only hand instruments and portable lights; do not use local anesthesia.
2. For children, use supine position on tables available in the schools; use a chairside assistant.
3. Remove plaque and debris from the involved pits and fissures with the tip of an explorer.
4. Use cotton wool rolls for isolation.
5. Perform conditioning: about 10 seconds by liquid component of the glass ionomer material diluted with an equal amount of water.
6. Wash, then dry.
7. Hand-mix the high-strength glass ionomer.
8. Use finger to press the glass ionomer into pits and fissures.
9. Remove excess restoration material with an excavator or carver.
10. Check occlusion.
11. No varnish or petroleum jelly was applied to protect the glass ionomer.

Citation: Staninec M, Artiga N, Gansky SA, Marshall GW, Eakle S. Bonded amalgam sealants and adhesive resin sealants: five-year clinical results. *Quintessence Int* 2004; 35(5):351–7.

Material: Conventional sealant (Bisco) vs. amalgam

Selection of Teeth and Tooth Type or Morphology: Permanent posterior teeth

Technique:
For amalgam:
1. Clean with prophylaxis toothbrush and nonfluoridated pumice.
2. Use rubber dam for isolation.
3. Etch with 32% phosphoric acid gel for 30 seconds.
4. Rinse for 30 seconds.
5. Dry gently, leaving surface slightly moist.
6. Apply All-Bond 2 Primer A & B mixture (Bisco) in different coats until the surface is glossy.
7. Dry the surface.
8. Light-cure the bonding agent for 30 seconds.
9. Paint mixed Liner F (Bisco) in a thin layer over the set primer.
10. Condense amalgam over the surface and burnish into all grooves.
11. Remove excess amalgam.
12. Remove rubber dam and check occlusion.

For resin sealant:
1. Use the same protocol as for amalgam, up to and including application of primer.
2. Place conventional sealant (Bisco) into all grooves.
3. Light-cure for 30 seconds.

Citation: Sundfeld RH, Mauro SJ, Briso AL, Sundfeld ML. Clinical/photographic evaluation of a single application of two sealants after eleven years. *Bull Tokyo Dent Coll* 2004; 45(2):67–75.

Material: Self-cure Concise (3M) *or* light-cured Prisma Shield (Caulk & Dentsply)

Selection of Teeth and Tooth Type or Morphology: Premolars

Technique:
1. Prophylaxis with pumice and water
2. Absolute isolation (technique not mentioned)
3. Etch: 37% phosphoric acid solution for 2 minutes
4. Rinse, dry
5. Apply sealant
6. Light-cure for 40 seconds in Prisma group

If minor chromatic alterations were located in the pits and fissures, with no evidence of incipient caries:
1. Surface preparation with a smooth spherical carbide ¼ drill
2. Prophylaxis with pumice and water
3. Absolute isolation (technique not mentioned)
4. Acid conditioning of the whole occlusal surface including the conservative cavities
5. Rinse, dry
6. Thin layer of adhesive material (Prisma Bond, Caulk & Dentsply) applied exclusively inside the conservative cavity, with no overlap on the borders
7. Sealant applied
8. Light-cure for 40 seconds in Prisma group

Citation: Taifour D, Frencken JE, van't Hof MA, Beiruti N, Truin GJ. Effects of glass ionomer sealants in newly erupted first molars after 5 years: a pilot study. *Community Dent Oral Epidemiol* 2003; 31(4):314–9.

Material: Fuji IX glass ionomer (GC Europe)

Selection of Teeth and Tooth Type or Morphology: Newly erupted first molars

Technique:
1. Use cotton wool rolls for isolation.
2. Clean occlusal surface with a probe.
3. Condition with polyacrylic acid for 10–15 seconds.
4. Wash, then dry with cotton wool pellets.
5. Place hand-mixed glass ionomer on occlusal surface with an applier instrument, and press finger, coated with petroleum jelly, into the pits and fissures.
6. Remove excess material with a carving instrument.
7. Coat the sealant with petroleum jelly.

Citation: Yildiz E, Dorter C, Efes B, Koray F. A comparative study of two fissure sealants: a 2-year clinical follow-up. *J Oral Rehabil* 2004; 31(10):979–84.

Material: Fluoride-containing Helioseal F fissure sealant, and conventional Concise Light Cure White Sealant fissure sealant

Selection of Teeth and Tooth Type or Morphology: First and second permanent molars

Technique:
1. Use cotton wool rolls for isolation, along with a flexible plastic saliva ejector.
2. Clean the tooth with a prophylaxis brush using nonfluoridated pumice.
3. Rinse, then dry.
4. Etch, rinse with water for 20 seconds, then dry with air blast (until tooth has chalky, frosted appearance).
5. Apply fissure sealant materials according to manufacturer's instructions.
6. Cure for 40 seconds with Coltolux 4 (Colténe, CH 9450, Switzerland) dental curing light.
7. No repair or replacement of insufficient sealants.

Citation : Pardi V, Pereira AC, Mialhe FL, Meneghim Mde C, Ambrosano GM. A 5-year evaluation of two glass-ionomer cements used as fissure sealants. *Community Dent Oral Epidemiol* 2003; 31(5):386–91.

Material: Vitremer resin-modified glass ionomer cement (3M ESPE, St Paul, Minn.) and Ketac-Bond conventional glass ionomer cement (3M ESPE)

Selection of Teeth and Tooth Type or Morphology: Permanent first molars

Technique:
1. Pumice prophylaxis of the occlusal surfaces
2. Cotton roll isolation
3. 30 seconds conditioning with 35% phosphoric acid gel
4. Wash, cotton roll substitution

Vitremer application:
1. Primer application for 30 seconds
2. Air-drying and light-curing for 20 seconds
3. Mixing of material in a 1:2 powder–liquid ratio, to obtain lower viscosity so that the mixture flows into the fissures
4. Insertion of material into fissures with an explorer, along the entire extension
5. Light-curing for 40 seconds
6. Application of "Finishing Gloss" followed by light-curing for 20 seconds
7. Verification and adjustment of occlusal contacts when necessary

Ketac-Bond application:
1. Mixing of material in a 1:1 powder–liquid ratio, to obtain a luting consistency
2. Insertion of material into fissures with an explorer, along the entire extension
3. 5-minute wait for initial curing mechanism
4. Material covered with unfilled resin to maintain moisture balance
5. Checking and adjustment of occlusal contacts when necessary

Citation: Puppin-Rontani RM, Baglioni-Gouvea ME, deGoes MF, Garcia-Godoy F. Compomer as a pit and fissure sealant: effectiveness and retention after 24 months. *J Dent Child (Chic)* 2006; 73(1):31–6.

Material: Fluoroshield (Dentsply International, York, Pa.) and Compoglass (Vivadent Ets, F1-9494 Schann/ Lichtenstein)

Bonding agent before application of Compoglass: Syntac single-component bonding agent

Selection of Teeth and Tooth type or Morphology: Permanent first molars

Technique:
Compoglass:
1. Clean teeth with child-size toothbrush and water.
2. Use cotton rolls for isolation and portable saliva ejector.
3. Wash, then dry.
4. No acid etching.
5. Apply bonding agent, followed by 20 seconds of light-curing, a second layer of bonding agent and another 20 seconds of light-curing.
6. Apply Compoglass with a suitable instrument, light-cure for 40 seconds.
7. Occlusion check

Fluoroshield:
1. Clean teeth with child-size toothbrush and water.
2. Use cotton rolls for isolation and portable saliva ejector.
3. Wash, then dry.
4. Etch with phosphoric acid for 30 seconds.
5. Apply sealant with a probe.
6. Perform occlusion check.

Citation: Lavonius E, Kerosuo E, Kervanto-Seppala S, Halttunen N, Vilkuna T, Pietila I. A 13-year follow-up of a comprehensive program of fissure sealing and resealing in Varkaus, Finland. *Acta Odontol Scand* 2002; 60(3):174–9.

Material: Light-curable Delton (Dentsply, York, Pa.)

Selection of Teeth and Tooth Type or Morphology: All first and second permanent molars, but no first and second premolars or primary molars

Technique:
1. Use cotton wool rolls for isolation.
2. Place sealants according to manufacturer's instructions, except for use of explorer instead of the applicator provided.
3. No general recommendation for preventive preparation of the tooth before sealing; however, some of the dentists used tapered fine diamond fissure to remove enamel caries or stains and to ensure that the lesion did not reach dentin before sealing.

Citation: Folke BD, Walton JL, Feigal RJ. Occlusal sealant success over ten years in a private practice: comparing longevity of sealants placed by dentists, hygienists, and assistants. *Pediatr Dent* 2004; 26(5):426–32.

Material:
- Fluroshield VLC (LD Caulk, Milford, Del.) or Ultraseal (Ultradent Products Inc., South Jordan, Utah)
- Bonding agent: 3M Scotch Bond Multi-Purpose Dental Adhesive or 3M Single Bond Dental Adhesive (3M, Irving, Calif.)

Selection of Teeth and Tooth Type or Morphology: Fully erupted permanent first molars

Technique:
1. Single practice setting
2. Cotton roll isolation
3. Minimal enameloplasty using a one-quarter round bur at high speed with light brushing motion
4. 15 seconds phosphoric acid gel etching
5. 5–10 seconds rinse
6. Air-dry
7. Application of bonding agent with a hand-held brush, air-thinned across the surface
8. Placement of sealant
9. 30 seconds of light-curing

Citation: Wendt LK, Koch G, Birkhed D. Long-term evaluation of a fissure sealing programme in Public Dental Service clinics in Sweden. *Swed Dent J* 2001; 25(2):61–5.

Material: Delton self-cure sealant (Johnson & Johnson Inc., Sollentuna, Sweden)

Selection of Teeth and Tooth Type or Morphology: All caries-free occlusal surfaces of permanent molars

Technique:
1. Clean fissure system using a brush and pumice, then a sharp probe.
2. Wash, then air-dry.
3. Use cotton rolls for isolation, along with triangular parotid duct absorbents.
4. Etch with phosphoric acid gel for 60 seconds.
5. Remove rolls, and wash and dry the fissures.
6. Apply new cotton roll.
7. Apply the fissure sealant.

Citation: Ram D, Mamber E, Fuks AB. Clinical performance of a non-rinse conditioning sealant in three paediatric dental practices: a retrospective study. *Int J Paediatr Dent* 2005; 15(1):61–6.

Material: Dyract Seal compomer sealant (Dentsply-De Trey, Germany) with nonrinse conditioning

Selection of teeth and tooth type/morphology: Primary and permanent molars

Technique:
1. Freshen tooth surface with a one-half round bur with a slow-speed engine
2. Cotton roll isolation
3. Application of nonrinse conditioner and Dyract Seal according to manufacturer's instructions