Evidence-Based Dentistry

Best Practices for Dental Sealants in Community Service-Learning


Abstract: Community service-learning (CSL) in predoctoral dental education might be an effective tool for increasing sealant use by dentists—thus benefitting underserved children while facilitating students’ learning of a clinical procedure in a real-life setting. This study reviewed the scientific literature on this topic in order to 1) evaluate the reasons for low sealant use among dentists, 2) consider important aspects of sealant use in community settings, and 3) identify best practices to use as guidelines for CSL regarding sealant use. As background, the MEDLINE database was searched with the key words “dental sealants” for human and laboratory studies in the English language. A total of 205 relevant articles were identified and overviewed. We found that the low use of sealants relate to dentists’ orientation toward restorations rather than prevention, distrust in sealant treatment, lack of confidence in caries risk assessment, and concern about sealing over caries. The aspects to consider in the CSL projects are acquisition of knowledge and necessary skills of operators, cost-benefit approach to sealant placement, and meticulous sealant placement procedures, including the necessity for a short-term recall.

Keywords: community service-learning, dental sealants, dental education

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Occlusal caries constitutes more than two-thirds of the total caries in the permanent posterior teeth of Western children.1 Systematic reviews have found strong evidence of sealant effectiveness on sound permanent posterior teeth in children and adolescents.2 Although contemporary caries epidemiology supports sealant usage3 as an effective method for prevention of occlusal caries,4 sealant use by dentists has been limited.4,5 There is also an inequality in sealant use as children most in need of sealants are at a disadvantage to receive them.6 Obviously, a change in dental practice for preserving tooth structure should be initiated,7 with more fissures sealed and fewer fissures restored than at current levels.8

Community service-learning (CSL) in predoctoral dental education might be an effective tool to initiate such change, as CSL teaches students to be socially responsible,9 culturally competent, and aware of the determinants of health in underserved communities.10,11 CSL fosters learning in unique ways because students not only learn clinical procedures in real-life settings, but they also experience the need for health care among those less fortunate than themselves.12 Through CSL, patients receive benefits from the sealants (service component), and dental students receive appropriate education (learning component) that prepares them to provide sealants for their future patients.13 Consequently, they will be more confident in sealant use as an effective caries prevention modality; and hopefully, as practitioners, they will be more willing than many current dentists to use this prevention modality with their patients. These future practitioners should also be able to be strong advocates for targeted school-based sealant programs in their communities and those nearby.

School-based programs generally target low-income children who are less likely than children from higher-income families to receive preventive services and to have a regular source of care.14 Therefore, the CSL-based sealant projects should focus on underserved, high-risk children with lim-
ited access to dental care, as they are least likely to seek or obtain preventive as well as operative oral care.\textsuperscript{7,15,16} Despite many high-risk children being eligible for dental insurance, many children are still unable to access or face great barriers in accessing dental care. Dental students should also serve as advocates for these children in accessing the dental care that is available for them. As part of the CSL and its preparation, students need to understand that our current systems do not ensure that children will receive timely restorations once they get cavities. It is important to consider that the ratio of restoration to sealant costs exceeds 12:1.\textsuperscript{17} Therefore, a focus on sealants is justified by these children’s lack of ongoing access to care and the higher likelihood that a cavity would not be restored promptly and the child would therefore be at risk of more morbidity as well as need for a larger filling or more extensive dental treatment. A clear distinction, however, has to be made regarding what is achievable in school-based programs vs. in a dental practice. Obviously, a better control of caries risk management, clinical procedures, choice of materials, patient recall, and compliance can be assured in a dental practice than in a school-based setting.

Therefore, our project aimed to support the efficient use of sealants by dental students in communities. To that end, it was important to identify important aspects and considerations for community-based dental education. Our specific aims were 1) to identify the reasons for low sealant use by dentists; 2) to consider possible modifiers of sealant success relevant to community projects; and 3) to suggest guidelines for sealant use in predoctoral dental community service-learning projects.

Results and Discussion

The results and discussion are presented according to each of the aims of the study.

Aim 1: Reasons for Dentists’ Low Sealant Use

Although sealants have been used to prevent occlusal caries for over thirty years,\textsuperscript{18} the dental profession has not used them to their greatest advantage.\textsuperscript{19} In general, the resistance of dentists to use sealants stemmed from several sources: dentists’ orientation toward restorations rather than prevention,\textsuperscript{20,21} distrust of the long-term benefits of sealant treatment,\textsuperscript{22,23} perceived economic factors, lack of confidence in caries risk assessment, and concern about inadvertently sealing over caries.\textsuperscript{7,22,24}

Concern about sealing over caries. Contemporary protocols for the treatment of dental caries support sealing over active noncavitated occlusal caries lesions.\textsuperscript{21,25-27} However, dentists are still hesitant to seal where there is a suspicion of active caries,\textsuperscript{19,20,28} despite the in vivo evidence that shows further progression of caries in the properly sealed carious lesions does not occur.\textsuperscript{29,31} Viable organisms under proper sealants are reduced or eliminated,\textsuperscript{32} and consequently both enamel and dentine caries are arrested.\textsuperscript{30} A meta-analysis of six studies of sealant placement on teeth with noncavitated carious lesions found that sealants reduced by 71 percent the lesions that progressed.\textsuperscript{33} Therefore, sealing caries should be considered as a better option than the alternatives such as dental neglect or extraction of teeth.\textsuperscript{33} Evidence-based clinical recommendations for the use of pit-and-fissure sealants by a panel of the American Dental Association’s Council on Scientific Affairs recommend placing them in children and adolescents on early (noncavitated) carious lesions.\textsuperscript{34} Consequently, dental students should be informed about unnecessary concerns.

Long-term preventive effects of sealant treatment. It is difficult to predict accurately what
the long-term success of sealant treatment might be as a precise comparison among studies is impossible because various criteria and follow-up periods have been used to measure the success of sealants. Seemingly, the main attribute of success would be placement of sealants on a tooth at high risk. Maintenance over time is also important as even after ten or more years following sealant placement, high retention rates of sealants (80 percent to 90 percent) were achieved when recall was incorporated. Moreover, even if fissure sealant programs serve only to delay rather than prevent the need for restorative care, there is still a substantial benefit to be gained, since it has been shown that the half-life of restorations is considerably greater if the child is older than nine years when a restoration is placed.

Caries risk assessments. The uneven distribution of dental caries among and within populations and the varying patterns of caries across tooth surfaces call for effective targeting of the available resources. Thus, caries risk analysis of the patient, as well as the tooth, is essential in the planning process of sealant treatment. Various aspects of risk assessment will be covered in subsequent sections.

Aim 2: Potential Modifiers of Sealant Success in Community Projects

A number of potential modifiers (risks) of the caries-preventive effect of fissure sealing have been suggested. In the context of CSL, patient-related risks, tooth-related risks, and operator- and procedure-related risks should be considered.

Patient-related factors. Similarly to other dental treatments, young and uncooperative patients might lead to a sealant failure. Thus, proper patient management is a key for success in any treatment. Another important consideration is that the cost-effectiveness of any public health strategy for preventing caries can be improved by targeting high-risk children, who otherwise receive limited care. High-risk children usually have a low socioeconomic background, consume a cariogenic diet, and have plaque load, a low-fluoride intake, previous dental caries history, and infrequent dental visits. The cost of providing sealants to every tooth in every child is beyond the means of most programs; therefore, cost-beneficial strategies for school-based programs should be considered.

Pit-and-fissure sealants can be used effectively as part of a comprehensive approach to caries prevention. A study of high-risk Swedish adolescents demonstrated that less of a caries increment was found for those who had at least one sealant and for those who belonged to the fluoride varnish group. A combined fluoride varnish application and sealant placement should be attempted in a CSL program because it may provide patients benefit and it gives students more clinical experience.

Tooth-related factors. Tooth location, eruption status, and fissure morphology have been related to sealant failures. That is, it has been demonstrated that sealants fail differently on different surfaces, or different sites, and sealant failure rates increase with multiple sealants. Thus, the cost-effective use of sealants should involve selective sealant application on teeth and surfaces with the greatest caries risk.

Regarding location, the caries preventive effect of sealants was demonstrated for permanent molars but not for premolars. The higher success rate was demonstrated in first molars as compared to second permanent molars, while mandibular teeth and mesial sites retained sealants better than maxillary teeth or distal sites. This might be due to direct vision, gravity flow of the resin, and generally well-defined pits and fissures in mandibular teeth. The retention of sealants on occlusal surfaces was 2.8 times better than on buccal and palatal pits, which have been identified as the two most frequent surfaces of sealant failures. Clinicians tend to avoid sealing these surfaces due to the frustration of early sealant loss. This clinical decision is not justified as a national survey found that buccal and palatal surfaces constitute a considerable part of the total caries, so caries in these surfaces should be prevented.

Regarding eruption status, newly erupted immature tooth enamel is more permeable and more susceptible to caries attack because of its relatively high organic content. This is especially true for erupting molars that are in the process of maturation. Moreover, enamel is thinner in pits and fissures, which allows accelerated demineralization into the dentin. Eruption time for molars is longer than for premolars, and it takes 1.5 years for the first molars and up to 2.5 years for the second molars to fully erupt. Not fully erupted teeth are at a particular risk for developing caries because the operculum covering the distal half of teeth during eruption allows for the retention of plaque and the initiation of the caries process before complete eruption. Moreover, during the eruption time, the teeth are in infraocclusion to the occlusal plane of the existent deciduous tooth's occlusal plane, which prevents effective toothbrush-
Sealant use has also been found to be successful when dental assistants or auxiliaries, even better when sealants were placed by trained sealant effectiveness has been found to be equal or the skill of the operator. Becomes clear that success is mainly determined by and dental hygienists. Method that can be easily applied by skilled dentists and pragmatic approach, concomitantly securing ease prevention and conservation of tooth structure and it has been related to less sealant penetration than a shallow fissure morphology. Shallow fissures may be more likely to be thoroughly cleaned and etched than deep fissures. To overcome the problems of deep constricted fissures, a mini-invasive technique for the placement of sealants has been employed. However, in the context of contemporary knowledge, the rationale for the mini-invasive technique needs to be reevaluated for the following reasons. First, evidence is at least inconsistent: although a few studies have found that mechanical preparation of the fissures improved retention compared to sealants placed on non-prepared fissures, other studies found only a slight improvement or no improvement in sealant retention. Second, assurance that hidden occlusal caries is detected is unnecessary, as evidence shows arrested caries under properly placed sealants. Moreover, changing technologies and an improved understanding of the caries process emphasize disease prevention and conservation of tooth structure over operative intervention.

Operator- and sealant placement-related factors. For projects in which suboptimal conditions may occur, it is important to employ the most practical and pragmatic approach, concomitantly securing the quality of sealant treatment. The success of the sealant treatment will be determined by an operator’s skill, preparation for the sealant placement, choice of materials, proper field isolation, and quality assurance in steps of the sealant placement.

Sealants have been shown to be a cost-effective method that can be easily applied by skilled dentists and dental hygienists. Reviewing the literature, it becomes clear that success is mainly determined by the skill of the operator. For example, long-term sealant effectiveness has been found to be equal or even better when sealants were placed by trained dental assistants or auxiliaries. The outcome of sealant use has also been found to be successful when dental students placed sealants. Consequently, with proper education and acquisition of necessary skills, dental students should be successful in placing sealants.

The maintenance of sealants is important, as they might fail even under the best circumstances. Patient recall in CSL programs is important as students are just acquiring the necessary clinical skills, so sealants placed by students may be lost at a higher rate than the ones placed by experienced practitioners. Thus, the recall is a necessity when students are providing the service. At the same time, more experienced practitioners may consider recall after sealant placement unnecessary and not cost-beneficial.

A systematic review found that, with single (no recall) sealant applications, the relative risk reduction (RRR) varied from 4 percent to 54 percent, and for repeated applications (recall included) the RRR ranged from 69 percent to 93 percent. Sealant retention decreases gradually, i.e., a 5 to 10 percent failure rate per year might be expected. Thus, in order to ensure maximum caries prevention, sealants should undergo evaluation, when loss of material, exposure of voids in the material, and potential for caries development are regularly assessed. The length of the recall should be sufficient as a continued susceptibility of pit-and-fissure caries up to nine years after eruption, and clinically significant changes in uncovered fissures have been demonstrated. The need for reapplication of sealants is usually highest during the first year after the sealant placement. Three-month, six-month, and annual recalls have been used, but the specific length of the recall should be based on the individual risk.

The difficult clinical decision to make is when sealants are only partially lost as there is no consistent evidence about when to replace partially lost sealants. Some studies have suggested that any considerable “partial loss” of sealant leaves a tooth equally susceptible to caries as an unsealed control tooth, while others report that partial retention has a lower caries rate than non-sealed teeth or missing sealant teeth. Other studies have found that partial retention and missing sealants showed no difference with caries preventive effects. Consequently, additional studies are needed to determine when to reseal partially lost sealants and what is the optimal time for the patient recall and to identify factors that will enable practitioners to target children with the highest degree of caries susceptibility for more frequent examination. Until more evidence is acquired, all lost and partially lost sealants should be replaced.
Patient management and proper field isolation are the two most important considerations for sealant success. One of the guidelines in sealant placement is to clean the surfaces with a prophy pumice prior to sealant placement. Given that a pumice prophylaxis does not significantly increase sealant bond strength and that this paste has been found in significant quantities in sealed fissure spaces, which may reduce retention of sealants, alternative cleaning methods should be considered. It has been demonstrated that cleaning the debris from the teeth by gently running a blunt explorer through the fissures and subsequently forcefully rinsing with water resulted in retention rates comparable to those achieved when teeth were cleaned by a prophy pumice. Moreover, the retention of sealants after cleaning with a toothbrush was at least as high as the one associated with a handpiece prophylaxis. It appears that different cleaning methods produce similar results and toothbrushing, which is already commonly used in school-based dental sealant programs, requires the least equipment and time. For CSL projects, simple toothbrushing should be prioritized over other cleaning methods. This practical and simplified approach is cost-beneficial and enables programs to serve more children.

Sealant application involves strict attention to detail and dry field isolation throughout the procedure. Although practitioners admit that rubber dam isolation is best, they do not use this type of isolation (i.e., a survey of over 1,000 pediatric dentists found that they preferred cotton roll isolation over a rubber dam). For CSL projects, obvious disadvantages of the rubber dam isolation are discomfort during a dam clamp placement, the need for a local anesthetic, difficulty in placing a clamp onto a partially erupted tooth, and an increase in the cost and need for sterilization of the armamentarium. Moreover, clinical studies comparing isolation using either a rubber dam or a cotton roll found no differences in sealant retention and caries; thus, proper isolation with cotton rolls should be adequate in sealant placement. The choice of cotton roll over rubber dam isolation will also lead to better patient management and saves time. To ensure the quality of the cotton roll isolation and of overall performance in sealant placement in community settings, four-handed dentistry is needed, so students should work in pairs.

Various etching modalities have been evaluated for sealant use, in which both liquid and gel etchants showed sufficient penetration, resulting in similar bond strength and clinical retention. For community projects, the gel etchant should be chosen as it allows easy control. The fifteen- or twenty-second etching and twenty-to-thirty-second rinse of etchant ensure sufficient bond strength and resistance to microleakage.

Various materials have been extensively used and evaluated as fissure sealants, but only principal differences between these materials will be discussed.

The rationale for using glass ionomer (GI) sealants was based on the fact that they are not as sensitive to moisture as resin-based (RB) sealants and that GI sealants release fluoride. However, the retention rates of GI sealants are low. Resin-based sealants are widely used because of their demonstrated track record and high retention rates.

Clinical studies have found that the presence or absence of fillers has virtually no effect on the clinical outcomes of resin-based sealants. At the same time, experimental studies have demonstrated that low viscosity (unfilled) sealants penetrated better, whereas high viscosity (filled) sealants did not penetrate enough to ensure a good marginal seal. Another important consideration is that filled sealants necessitate occlusal adjustment. The time necessary for the occlusal adjustment is clearly not desirable in community projects because a smaller number of children will receive sealants. For that reason, unfilled sealants, which are already most commonly used in school programs, will also be a good choice for community projects. A systematic review concluded that no studies documented a clinical benefit with fluoride releasing resin sealant; thus, the preference for the fluoride sealant is just a matter of choice.

The advantages of colored sealants vs. clear sealants are that colored ones are visible, i.e., they are easier to assess during both the application and follow-up procedures. Moreover, the identification error rate for the colored resin sealants has been found to be considerably less than for the clear resin sealants. On the other hand, the argument against colored sealants has been that they preclude visual examination for caries of the sealed fissure. This argument has been clearly disproven by evidence that well-sealed caries underneath properly placed sealants does not progress.

Comparable bond strengths and retention rates between autopolymerizing (chemically cured) and light-cured sealants have been reported. Self-etch adhesives raised a particular interest in research as they do not require rinsing or changing of cotton
rolls;\textsuperscript{109} thus, if effective, these materials might be desirable for application under field conditions. However, a closer look at studies shows that at present the use of self-etch adhesives is not justified: the bonding of available self-etching adhesives to enamel is inferior to that achieved with total etch systems.\textsuperscript{110,111} Moreover, in saliva-contaminated sites, self-etch adhesives or etching were equally unacceptable as the total failure rate was around 60 percent for both materials.\textsuperscript{112} This means that, in saliva contamination, RB sealants with or without etching are ineffective,\textsuperscript{113} so self-etch adhesives cannot be recommended either for clinical or community sealant projects.

Saliva contamination before sealant placement is the most commonly reported reason for sealant failure.\textsuperscript{42} Saliva contamination is also hard to avoid in a young patient,\textsuperscript{114} so the protective effect of bonding materials in saliva-contaminated surfaces was of particular research interest. Although one laboratory study found that sealant retention is possible on wet surfaces if a bonding agent is used between enamel and sealant,\textsuperscript{88} clinical trials have found that using bonding agent does not increase retention rate.\textsuperscript{115,116} Moreover, the use of bonding agents increases both the time and the cost of the sealant application; thus, this option should be carefully weighed before adopting it,\textsuperscript{65} particularly for community projects in which both cost-benefit and time are important considerations.

Overall, the evidence supports sealant use in community projects given that the operator has the necessary skills and knowledge, teeth and surfaces at risk either sound and/or with noncavitated caries are sealed, the steps of sealant placement procedure are meticulously followed, and at least one recall is in place.

**Aim 3: Guidelines for Sealant Use in Community-Based Dental Education**

The following guidelines are suggested in applying practical and pragmatic principles, thus securing quality assurance in both treatment and follow-up procedures.

**Prior to the implementation of a community sealant program**

- In order to acquire the necessary knowledge and understanding, students should receive a thorough didactic preparation with the following themes: infection control, management of a child patient, caries risk assessment and management, factors related to sealant success and failure, and sealants maintenance.
- In order to acquire good operational skills for the CSL program, students should practice both field isolation and a meticulous sealant application technique under the supervision of experienced operators (e.g., dental hygienists and trained auxiliaries). Students are allowed to place sealants in the community sites only after the necessary skills have been acquired.

**Preparation for the sealant implementation**

- In order to increase the cost-effectiveness of sealant use and benefit underserved populations, children from low socioeconomic areas should be chosen, and all pits and fissures of their permanent molars should be sealed.\textsuperscript{2}
- The best age for sealant placement should be between seven and ten years. Prior to sealant placement, children should be prescreened for their caries risk and behavior management. Only cooperative children, whose eruption status of permanent molars allows for proper field isolation with cotton rolls, should be selected for a CSL sealant program.
- Given difficulties inherent in patient management under suboptimal conditions and a lack of experience in behavior management, uncooperative children should be referred to a dental practitioner who has the necessary patient management skills.

**Sealant placement procedures**

- A portable operatory and the necessary infection control environment are created in the school setting.
- Prior to the sealant placement, children receive a supervised toothbrushing, and the sealant placement procedure is explained to the child following the tell-show-do strategy.
- During the sealant placement, students work in pairs. One student takes care of the field isolation with cotton rolls supplemented by portable water and a suction system, and the other student performs the steps of the sealant placement procedure.
- A fifteen-second etching with a colored 35 percent phosphoric acid gel should be applied onto all susceptible pits and fissures of the tooth and extended up to the cuspal inclines well beyond the anticipated margin of the sealant. A fifteen-second rinsing after the etching should be employed, and the quality of etching should always be assessed during the tooth drying. If the field is contaminated after the etching, the etching should be reapplied, followed by rinsing and drying.
• Light-cured unfilled opaque sealants should be prioritized over auto-cured filled sealants, and sealants should cover fissures sufficiently, but not excessively, in order to avoid occlusal discrepancies and patient discomfort. Given only unfilled sealants are used, occlusal adjustments are not necessary.
• To optimize caries prevention, a fluoride varnish may be applied after sealant placement.117

Recall procedure
• In CSL sealant programs, sealant retention should be evaluated after one year.
• To maximize the learning experience, the recall is performed by the same students who placed the sealants a year ago. All missing or partially missing sealants should be replaced at a recall appointment.
• If a child will be further followed in the dental practice, the recall frequency should be individualized and based upon the child’s caries risk situation.

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