Executive summary follows page 356

Evidence-based clinical recommendations for the use of pit-and-fissure sealants

A report of the American Dental Association Council on Scientific Affairs

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ABSTRACT

Background. This article presents evidence-based clinical recommendations for use of pit-and-fissure sealants developed by an expert panel convened by the American Dental Association Council on Scientific Affairs. The panel addressed the following clinical questions: Under what circumstances should sealants be placed to prevent caries? Does placing sealants over early (noncavitated) lesions prevent progression of the lesion? Are there conditions that favor the placement of resin-based versus. glass ionomer cement sealants in terms of retention or caries prevention? Are there any techniques that could improve sealants' retention and effectiveness in caries prevention?

Types of Studies Reviewed. Staff of the ADA Division of Science conducted a MEDLINE search to identify systematic reviews and clinical studies published after the identified systematic reviews. At the panel's request, the ADA Division of Science staff conducted additional searches for clinical studies related to specific topics. The Centers for Disease Control and Prevention also provided unpublished systematic reviews that since have been accepted for publication.

Results. The expert panel developed clinical recommendations for each clinical question. The panel concluded that sealants are effective in caries prevention and that sealants can prevent the progression of early noncavitated carious lesions.

Clinical Implications. These recommendations are presented as a resource to be considered in the clinical decision-making process. As part of the evidence-based approach to care, these clinical recommendations should be integrated with the practitioner's professional judgment and the patient's needs and preferences. The evidence indicates that sealants can be used effectively to prevent the initiation and progression of dental caries.

Key Words. Sealant; pit-and-fissure sealant; caries; caries prevention; primary prevention; secondary prevention; evidence-based dentistry; clinical recommendations.
JADA 2008;139(3):257-267.

While dental sealants have been recognized as an effective approach to preventing pit-and-fissure caries in children,[1-5] clinical questions remain about the indications for placing pit-and-fissure sealants, the criteria for their placement over early caries (that is, noncavitated caries) and techniques to optimize retention and effectiveness. This report on the clinical recommendations for use of pit-and-fissure sealants presents a critical evaluation and summary of relevant scientific evidence to assist clinicians with their clinical decision-making process.

USE OF SEALANTS: AN EVIDENCE-BASED APPROACH

Dentistry is a dynamic profession, continually reshaped by

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new science, devices, techniques and materials, all of which have increased rapidly since many of today's practicing dentists were trained. During the past 30 years, evidence-based approaches have developed that involve rigorous summary of findings from clinical studies about the effectiveness of preventive and treatment strategies, with the aim of providing the best available information to clinicians for decision making. In a changing practice environment, it is important that educational institutions and providers of continuing education continually update the state of the evidence related to the effectiveness of sealants in dental caries prevention and management.

Clinical decision making reflects the intersection of science, professional judgment and patients' desires. Decisions about sealant use should be based on the best available evidence about the effectiveness of the intervention and on knowledge of the epidemiology of dental caries (risk factors and patterns of disease). Therefore, this report includes a section addressing caries prevalence according to tooth surface and population group. This information should help to ensure that sealants are used appropriately within the context of these recommendations.

This report was developed through a critical evaluation of the collective body of published scientific evidence, conducted by an expert panel that was convened by the American Dental Association Council on Scientific Affairs. These clinical recommendations are not a standard of care, but rather a useful tool for dentists to use in making clinically sound decisions about sealant use. These clinical recommendations should be integrated with the practitioner's professional judgment and the individual patient's needs and preferences. While these recommendations are applicable to multiple settings, the Centers for Disease Control and Prevention (CDC) is developing recommendations for use of pit-and-fissure sealants specific for school-based programs.

CARIES: DEFINITION AND PREVENTION

Definition of dental caries. This report defines caries as the manifestation of the stage of the caries process at any given point in time.[6] The caries process occurs across time as an interaction between biofilm (that is, dental plaque) and the tooth surface and subsurface.[6] The bacteria in biofilm are metabolically active, which causes fluctuations in plaque fluid pH. These fluctuations may cause a loss of mineral from the tooth when the pH level is dropping or a gain of mineral when the pH level is increasing.[7,8] Progression occurs when the equilibrium between demineralization and remineralization is imbalanced, leading to a net mineral loss. In clinical care settings, diagnosis of caries implies not only determining whether caries is present (that is, detection) but also determining if the disease is arrested or active and, if active, progressing rapidly or slowly.[7,9]

Caries is an infectious oral disease that can be arrested in its early stages. Caries can be prevented and managed in many ways. Approaches include primary prevention, defined as interventions provided to avert the onset of caries, and secondary prevention, defined as interventions to avert the progression of early caries to cavitation.

Epidemiology. In data from 2004, 42 percent of children and young adults aged 6 to 19 years had dental caries (decayed or filled) in their permanent teeth.[10] Prevalence of dental caries increases with age, ranging from 21 percent among those aged 6 to 11 years to 67 percent among adolescents aged 16 to 19 years.[10] The prevalence of dental caries is higher among children from low-income families and those of Mexican-American ethnicity.[10] Overall, about one-quarter of carious surfaces remain untreated in children and young adults with any caries. About 90 percent of carious lesions are found in the pits and fissures of permanent posterior teeth.[10] These data also indicate that around 40 percent of children aged 2 to 8 years have experienced dental caries (decayed or filled) in their primary teeth.[10] Similar to the findings for the permanent teeth, the prevalence of dental caries and of untreated decay in the primary teeth is higher among children from low-income families and those of Mexican-American ethnicity.[10] Overall, about one-half of carious surfaces remain untreated among children with any caries. About 44 percent of carious lesions in primary teeth are found on the pits and fissures of molars.[10]

The role of pit-and-fissure sealants in primary and secondary prevention. Pit-and-fissure sealants can be used effectively as part of a comprehensive approach to caries prevention on

ABBREVIATION KEY. ADA CEBD: American Dental Association Center for Evidence-based Dentistry. **BPA:** Bisphenol-A. **CDC:** Centers for Disease Control and Prevention.

an individual basis or as a public health measure for at-risk populations. Sealants are placed to prevent caries initiation and to arrest caries progression by providing a physical barrier that inhibits microorganisms and food particles from collecting in pits and fissures. It is generally accepted that the effectiveness of sealants for caries prevention depends on long-term retention.[5,11,12] Full retention of sealants can be evaluated through visual and tactile examinations. In situations in which a sealant has been lost or partially retained, the sealant should be reapplied to ensure effectiveness.

Pit-and-fissure sealants are underused, particularly among those at high risk of experiencing caries; that population includes children in lower-income and certain racial and ethnic groups.[13] The national oral health objectives for dental sealants, as stated in the U.S. Department of Health and Human Services initiative Healthy People 2010, includes increasing the proportion of children who have received dental sealants on their molar teeth to 50 percent.[14] However, national data collected from 1999 through 2002 indicated that sealant prevalence on permanent teeth among children aged 6 to 11 years was 30.5 percent,[15] but this represents a substantial increase over the 8 percent prevalence reported in a survey conducted in 1986 and 1987.[16]

Types of sealant materials and placement techniques. Two predominant types of pit-and-fissure sealant materials are available: resin-based sealants and glass ionomer cements. Available resin-based sealant materials can be polymerized by autopolymerization, photopolymerization using visible light or a combination of the two processes.[11]

Glass ionomer cements are available in two forms, both of which contain fluoride: conventional and resin-modified.[17] Glass ionomer cements, which do not require acid etching of the tooth surface, generally are easier to place than are resin-based sealants. They also are not as moisture-sensitive as their resin-based counterparts. Glass ionomer materials, which were developed for their ability to release fluoride, can bond directly with enamel. It is hypothesized that release of fluoride from this material may contribute to caries prevention. However, the clinical effect of fluoride release from glass ionomer cement is not well-established. Clinical studies have provided conflicting evidence as to whether these materials significantly prevent or inhibit caries and affect the growth of caries-associated bacteria compared with materials not containing fluoride.[18-20]

A transient amount of bisphenol-A (BPA) may be detected in the saliva of some patients immediately after initial application of certain sealants as a result of the action of salivary enzymes on bisphenol-dimethacrylate, a component of some sealant materials.[21-24] According to research, systemic BPA has not been detected as a result of the use of such sealants, and potential estrogenicity at such low levels of exposure has not been documented.[22]

Pit-and-fissure sealant materials vary, as do the techniques used to place them. Manufacturers' instructions for effective placement and long-term retention of resin-based sealants typically include cleaning pits and fissures, appropriately acid etching surfaces and maintaining a dry field uncontaminated by saliva until the sealant is placed and cured. Supplemental techniques and recommendations as cited in the literature may include using bonding agents; using various forms of mechanical enamel preparation, such as air abrasion and modification with a bur (enameloplasty); and using the four-handed application technique.

Bonding agents, also known as adhesives, may be used when applying pit-and-fissure sealants. Current bonding systems are marketed as total- and self-etch systems. The total-etch systems involve a three- or two-step placement technique, with a separate step for acid etching. The self-etch systems are packaged either as self-etching primers with separate adhesives or all-in-one systems that combine acid etchants, primers and adhesives. Both systems are available in single or multiple bottles.[25]

Clinical questions regarding pit-and-fissure sealants. Although the scientific evidence supports the use of pit-and-fissure sealants as an effective caries-preventive measure, clinical questions remain about the indications for placing pit-and-fissure sealants, criteria for their placement over early (noncavitated) caries and techniques to optimize retention and caries prevention. To address these topics, the expert panel considered the following clinical questions:

- Under what circumstances should sealants be placed to prevent caries?
- Does placing sealants over early (noncavitated) lesions prevent progression of the lesions?
- Are there conditions that favor the placement

of resin-based versus glass ionomer cement sealants in terms of retention or caries prevention?

- Are there any techniques that could improve sealants' retention and effectiveness in caries prevention?

These clinical recommendations do not address the cost-effectiveness of using pit-and-fissure sealants. However, multiple models have shown that basing selection criteria for sealant placement on caries risk is cost-effective.[26,27] Readers are referred to resources cited in the reference list for further discussion of cost-effectiveness.[26-33]

METHODS

In this report, we provide an abbreviated description of the review method we used. The full methods, including the complete search strategy, are provided as Appendix 1 in supplemental data to the online version of this article (visit "http://jada.ada.org").

The ADA Council on Scientific Affairs convened a panel of experts to evaluate the systematic reviews and clinical trials identified by staff of the ADA Center for Evidence-based Dentistry (CEBD). The council selected panelists on the basis of their expertise in the relevant subject matter. The expert panel convened at a workshop held at the ADA Headquarters in Chicago Nov. 13-15, 2006, to evaluate the collective evidence and develop evidence-based clinical recommendations for use of pit-and-fissure sealants.

CEBD staff members searched MEDLINE to identify systematic reviews that addressed the four clinical questions.[2,5,34-42] They conducted a second search to identify clinical studies published since the identified systematic reviews were conducted.[17,33,43-78]

Members of the expert panel (B.G. and W.K.) presented an unpublished manuscript that examined individual studies included in three recent systematic reviews regarding sealant effectiveness.[2,5,79] (That manuscript now has been published.[80]) CDC completed a multivariate analysis of factors associated with sealant retention, including use of the two-handed method versus the four-handed method. The included studies evaluated the retention of second- or third-generation resin-based sealant materials and provided data on whether the sealant was applied with the two-handed or the four-handed method.[80]

For each identified systematic review and clinical study, the panel determined the final exclusion of publications. They excluded publications on the basis of the following criteria: they did not directly address one of the identified clinical questions; the sealant materials they described were not available in the United States; and the panelists had concerns about the methodology described. Appendix 2 in the supplemental data online is a list of excluded publications.

For each included publication, the panel developed an evidence statement and graded it according to a system modified from that of Shekelle and colleagues[81] (Table 1). The panel developed clinical recommendations that were based on the evidence statements. They classified clinical recommendations according to the strength of the evidence that forms the basis for the recommendation, again using a system modified from that of Shekelle and colleagues[81] (Table 2). It is important to note that while the classification of the recommendation may not directly reflect the importance of the recommendation, it does reflect the quality of scientific evidence that supports the recommendation. Because the effectiveness of sealants depends on clinical retention,[5,11,12] the panelists chose to accept clinical sealant retention as a reasonable proxy for caries prevention.

The panel submitted these clinical recommendations to numerous scientific experts and organizations for review. The expert panel scrutinized all comments received and made appropriate revisions in the recommendations. (Appendix 3 in the supplemental data online provides a list of external reviewers.) The final clinical recommendations were approved by the ADA Council on Scientific Affairs.

PANEL CONCLUSIONS BASED ON THE EVIDENCE

The following evidence statements and corresponding classification of evidence (in parentheses) represent the conclusions of the expert panel.

Evidence regarding sealants for caries prevention.

- Placement of resin-based sealants on the permanent molars of children and adolescents is effective for caries reduction[5] (Ia).
- Reduction of caries incidence in children and adolescents after placement of resin-based sealants ranges from 86 percent at one year to 78.6 percent at two years and 58.6 percent at four years[2,5] (Ia).

- Sealants are effective in reducing occlusal caries incidence in permanent first molars of children, with caries reductions of 76.3 percent at four years, when sealants were reapplied as needed. Caries reduction was 65 percent at nine years from initial treatment, with no reapplication during the last five years[47] (Ib).
- Pit-and-fissure sealants are retained on primary molars at a rate of 74.0 to 96.3 percent at one year[59] and 70.6 to 76.5 percent at 2.8 years[59,61] (III).
- There is consistent evidence from private dental insurance and Medicaid databases that placement of sealants on first and second permanent molars in children and adolescents is associated with reductions in the subsequent provision of restorative services[33,66] (III).
- Evidence from Medicaid claims data for children who were continuously enrolled for four years indicates that sealed permanent molars are less likely to receive restorative treatment, that the time between receiving sealants and receiving restorative treatment is greater, and that the restorations were less extensive than those in permanent molars that were unsealed[46] (III).

TABLE 1

System used for grading the evidence.*

GRADE	CATEGORY OF EVIDENCE
Ia	Evidence from systematic reviews of randomized controlled trials
Ib	Evidence from at least one randomized controlled trial
IIa	Evidence from at least one controlled study without randomization
IIb	Evidence from at least one other type of quasiexperimental study, such as time series analysis or studies in which the unit of analysis is not the individual
III	Evidence from nonexperimental descriptive studies, such as comparative studies, correlation studies, cohort studies and case-control studies
IV	Evidence from expert committee reports or opinions or clinical experience of respected authorities

* Amended with permission of the BMJ Publishing Group from Shekelle and colleagues.[81]

TABLE 2

System used for classifying the strength of the recommendations.*

CLASSIFICATION	STRENGTH OF RECOMMENDATIONS
A	Directly based on category I evidence
B	Directly based on category II evidence or extrapolated recommendation from category I evidence
C	Directly based on category III evidence or extrapolated recommendation from category I or II evidence
D	Directly based on category IV evidence or extrapolated recommendation from category I, II or III evidence

* Amended with permission of the BMJ Publishing Group from Shekelle and colleagues.[81]

Evidence regarding placing sealants over early (noncavitated) lesions.

- Placement of pit-and-fissure sealants significantly reduces the percentage of noncavitated carious lesions that progress in children, adolescents and young adults for as long as five years after sealant placement, compared with unsealed teeth[82] (Ia).
- There are no findings that bacteria increase under sealants. When placed over existing caries, sealants lower the number of viable bacteria by at least 100-fold and reduce the number of lesions with any viable bacteria by 50 percent[83] (Ia).

Evidence regarding sealant materials.

- Results in two of three reviewed studies indicate that resin-based sealants are more effective in caries reduction at 24 to 44 months after placement than is glass ionomer cement in permanent teeth of children and adolescents[5,65,84,85] (Ia).
- There is limited and conflicting evidence that glass ionomer cement reduces caries incidence in permanent teeth of children[17,50,51,55,65] (Ib), although retention rates of glass ionomer cement are low[5] (Ia).
- In a population with a low caries incidence, use of glass ionomer cement is not effective in reducing the incidence of caries when placed in caries-free first primary molars[48] (Ib).

Evidence regarding sealant placement techniques.

- There is limited and inconclusive evidence in favor of using air abrasion as a cleaning method before acid etching to improve sealant retention[57] (IIb).
- The use of air abrasion instead of acid etching

reduces the rate of sealant retention[74,75] (Ib).
- There is limited and conflicting evidence that mechanical preparation with a bur results in higher retention rates in children[72,73,77] (IIb).
- There is indirect evidence that use of the four-handed technique when placing resin-based sealants is associated with improved retention rates[80] (III).
- Sealant retention can be improved if the clinician applies a bonding agent that contains both an adhesive and a primer between the previously acid-etched enamel surface and the sealant material[67,68] (Ib).
- Presently available self-etching bonding agents, which do not involve a separate etching step, provide comparable or less retention than do bonding agents that involve a separate acid-etching step[69,70] (Ib).

CLINICAL RECOMMENDATIONS

The expert panel makes the following evidence-based recommendations for each question regarding the placement of pit-and-fissure sealants (Table 3). The strength of each recommendation is assigned on the basis of the level of evidence associated with each recommendation, as described in the Methods section. In instances in which the recommendation is extrapolated from the evidence, the strength of the recommendation is lowered to reflect the extrapolation. Qualifying notes on the recommendations appear in Box 1. After reviewing the evidence and developing the recommendations, the expert panel identified several areas in which additional research is necessary to answer many questions regarding pit-and-fissure sealants and provide further evidence (Box 2, page 264).

Pit-and-fissure sealant placement for caries prevention.
- Sealants should be placed on pits and fissures of children's primary teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries[59,61] (III, D).*†
- Sealants should be placed on pits and fissures of children's and adolescents' permanent teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries[2,5,33,46,47,55,66] (Ia, B).*†
- Sealants should be placed on pits and fissures of adults' permanent teeth when it is determined that the tooth, or the patient, is at risk of experiencing caries[2,5,33,46,47,55,66] (Ia, D).*†

Pit-and-fissure sealant placement over early (noncavitated) carious lesions‡ to prevent progression.
- Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in children, adolescents and young adults to reduce the percentage of lesions that progress[82] (Ia, B).†
- Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in adults to reduce the percentage of lesions that progress[82] (Ia, D).†

Conditions that favor the placement of resin-based versus glass ionomer cement.
- Resin-based sealants are the first choice of material for dental sealants[5,50] (Ia, A).
- Glass ionomer cement may be used as an interim preventive agent when there are indications for placement of a resin-based sealant but concerns about moisture control may compromise such placement[17,50,51,55,65] (IV,D).§

Placement techniques for pit-and-fissure sealants.
- A compatible¶ one-bottle bonding agent, which

BOX 1

Qualifying notes on clinical recommendations.

* Change in caries susceptibility can occur. It is important to consider that the risk of developing dental caries exists on a continuum and changes across time as risk factors change. Therefore, clinicians should re-evaluate each patient's caries risk status periodically.
† Clinicians should use recent radiographs, if available, in the decision-making process, but should not obtain radiographs for the sole purpose of placing sealants. Clinicians should consult the American Dental Association/U.S. Food and Drug Administration[86] guidelines regarding selection criteria for dental radiographs.
‡ "Noncavitated carious lesion" refers to pits and fissures in fully erupted teeth that may display discoloration not due to extrinsic staining, developmental opacities or fluorosis. The discoloration may be confined to the size of a pit or fissure or may extend to the cusp inclines surrounding a pit or fissure. The tooth surface should have no evidence of a shadow indicating dentinal caries, and, if radiographs are available, they should be evaluated to determine that neither the occlusal nor proximal surfaces have signs of dentinal caries.
§ These clinical recommendations offer two options for situations in which moisture control, such as with a newly erupted tooth at risk of developing caries, patient compliance or both are a concern. These options include use of a glass ionomer cement material or use of a compatible one-bottle bonding agent, which contains both an adhesive and a primer. Clinicians should use their expertise to determine which technique is most appropriate for an individual patient.
¶ Clinicians should consult with the manufacturer of the adhesive and/or sealant to determine material compatibility.

TABLE 3

Summary of evidence-based clinical recommendations regarding pit-and-fissure sealants.

The clinical recommendations in this table are a resource for dentists to use in clinical decision making. These clinical recommendations must be balanced with the practitioner's professional judgment and the individual patient's needs and preferences.

Dentists are encouraged to employ caries risk assessment strategies to determine whether placement of pit-and-fissure sealants is indicated as a primary preventive measure. The risk of experiencing dental caries exists on a continuum and changes across time as risk factors change. Therefore, caries risk status should be re-evaluated periodically. Manufacturers' instructions for sealant placement should be consulted, and a dry field should be maintained during placement.

TOPIC	RECOMMENDATION	GRADE OF EVIDENCE	STRENGTH OF RECOMMENDATION
Caries Prevention	Sealants should be placed in pits and fissures of **children's** primary teeth when it is determined that the tooth, or the patient, is at risk of developing caries*†	III	D
	Sealants should be placed on pits and fissures of **children's** and **adolescents'** permanent teeth when it is determined that the tooth, or the patient, is at risk of developing caries*†	Ia	B
	Sealants should be placed on pits and fissures of **adults'** permanent teeth when it is determined that the tooth, or the patient, is at risk of developing caries*†	Ia	D
Noncavitated Carious Lesions‡	Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in **children**, **adolescents** and **young adults** to reduce the percentage of lesions that progress†	Ia	B
	Pit-and-fissure sealants should be placed on early (noncavitated) carious lesions, as defined in this document, in **adults** to reduce the percentage of lesions that progress†	Ia	D
Resin-Based Versus Glass Ionomer Cement	Resin-based sealants are the first choice of material for dental sealants	Ia	A
	Glass ionomer cement may be used as an interim preventive agent when there are indications for placement of a resin-based sealant but concerns about moisture control may compromise such placement§	IV	D
Placement Techniques	A compatible¶ one-bottle bonding agent, which contains both an adhesive and a primer, may be used between the previously acid-etched enamel surface and the sealant material when, in the opinion of the dental professional, the bonding agent would enhance sealant retention in the clinical situation§	Ib	B
	Use of available self-etching bonding agents, which do not involve a separate etching step, may provide less retention than the standard acid-etching technique and is not recommended	Ib	B
	Routine mechanical preparation of enamel before acid etching is not recommended	IIb	B
	When possible, a four-handed technique should be used for placement of resin-based sealants	III	C
	When possible, a four-handed technique should be used for placement of glass ionomer cement sealants	IV	D
	The oral health care professional should monitor and reapply sealants as needed to maximize effectiveness	IV	D

* Change in caries susceptibility can occur. It is important to consider that the risk of developing dental caries exists on a continuum and changes across time as risk factors change. Therefore, clinicians should re-evaluate each patient's caries risk status periodically.

† Clinicians should use recent radiographs, if available, in the decision-making process, but should not obtain radiographs for the sole purpose of placing sealants. Clinicians should consult the American Dental Association/U.S. Food and Drug Administration[86] guidelines regarding selection criteria for dental radiographs.

‡ "Noncavitated carious lesion" refers to pits and fissures in fully erupted teeth that may display discoloration not due to extrinsic staining, developmental opacities or fluorosis. The discoloration may be confined to the size of a pit or fissure or may extend to the cusp inclines surrounding a pit or fissure. The tooth surface should have no evidence of a shadow indicating dentinal caries, and, if radiographs are available, they should be evaluated to determine that neither the occlusal nor the proximal surfaces have signs of dentinal caries.

§ These clinical recommendations offer two options for situations in which moisture control, such as with a newly erupted tooth at risk of developing caries, patient compliance or both are a concern. These options include use of a glass ionomer cement material or use of a compatible one-bottle bonding agent, which contains both an adhesive and a primer. Clinicians should use their expertise to determine which technique is most appropriate for an individual patient.

¶ Clinicians should consult with the manufacturer of the adhesive and/or sealant to determine material compatibility.

BOX 2

Research recommendations.

The expert panel identified the following topics as areas for additional research to provide a stronger evidence base for the application of pit-and-fissure sealants for caries prevention. These research topics have not been arranged in order of priority.

PREVENTIVE EFFECTIVENESS AND COST-EFFECTIVENESS OF VARIOUS PROTOCOLS FOR SELECTION OF PATIENTS AND TEETH FOR SEALANT PLACEMENT

- Systematic review of evidence from insurance databases regarding the effectiveness and potential cost-effectiveness of sealants in preventing caries
- Clinical trials regarding the sealing of noncavitated and cavitated carious lesions using standardized diagnostic criteria
- Clinical trials regarding the sealing of noncavitated smooth-surface lesions
- Clinical trials regarding placement of sealants in adults
- Clinical trials regarding placement of sealants on surfaces other than the occlusal surfaces of permanent molars, including premolars, buccal and lingual pits of molars and cingula of anterior teeth
- Effectiveness of different management options for noncavitated carious lesions
- Methods to determine arrest of dentinal caries as measure of sealant effectiveness
- Clinical trials regarding minimally invasive techniques to manage early caries (noncavitated) and cavitated carious lesions
- Clinical methods to detect when an early (noncavitated) carious lesion is active or nonactive (that is, arrested)
- Cost-effectiveness of caries-management strategies

TIMING OF SEALANT APPLICATION

- Clinical trials using sealants in adults
- Clinical trials using sealants in primary teeth
- The timing of caries initiation and subsequent progression of pit-and-fissure caries in contemporary populations of various caries-risk status

RESEARCH REGARDING SEALANT MATERIALS AND RETENTION

- Enamel penetration of the materials used in the sealant application process
- Depth of polymerization of sealant materials as it affects sealant retention
- Additional studies regarding the factors that affect clinical retention and effectiveness of sealants
- Evaluation of the effect of fissure-cleansing methods and materials, including laser use, on clinical outcomes
- Effectiveness of self-etching primers in enhancing clinical sealant retention
- Effectiveness of isolation techniques, including rubber-dam and four-handed technique
- Evaluation of changes in retention associated with new products (such as bonding agents)
- Research and systematic reviews regarding the use of bonding agents to enhance sealant retention
- Effect of one-step adhesives on sealant retention
- Retention of light-cured sealants
- Effect of mechanical preparation on sealant retention

POINT-OF-CARE APPLICATION OF GUIDELINES

- Translation of sealant guidelines into clinical practice

contains both an adhesive and a primer, may be used between the previously acid-etched enamel surface and the sealant material when, in the opinion of the dental professional, the bonding agent would enhance sealant retention in the clinical situation[67,68] (Ib, B).[§]

- Use of available self-etching bonding agents, which do not involve a separate etching step, may provide less retention than the standard acid-etching technique and is not recommended[69,70] (Ib, B).
- Routine mechanical preparation of enamel before acid etching is not recommended[57,72-75,77] (IIb, B).
- When possible, a four-handed technique should be used for placement of resin-based sealants[80] (III, C).
- When possible, a four-handed technique should be used for placement of glass ionomer cement sealants[80] (IV, D).
- The oral health care professional should monitor and reapply sealants as needed to maximize effectiveness (IV, D). He or she should consult the manufacturer's instructions for sealant placement and maintain a dry, isolated field during placement.

CARIES RISK

The panel encourages dentists to use caries risk assessment strategies in their practices. Multiple models have showed that basing selection criteria for sealants on the patient's caries risk is cost-effective.[26,27] It also is important to consider that the risk of experiencing dental caries exists on a continuum and changes across time as risk factors change.[87] Therefore, a patient's caries risk status should be re-evaluated periodically. The panel recognizes that there is not a single system of caries risk assessment that has been shown to be valid and reliable. However, dentists can use clinical indicators to classify caries risk status to predict future caries experience. Caries risk assessment should be integrated with the practitioner's professional expertise to determine treatment

Figure 1. Tooth surface with an early (noncavitated) carious lesion that exhibits a white demineralization line around the margin of the pit and fissure and /or a light brown discoloration within the confines of the pit-and-fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

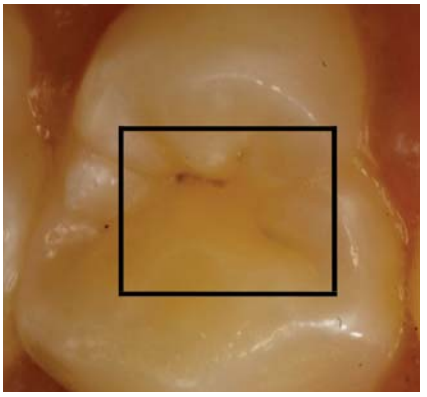

Figure 2. A small, distinct, dark brown early (noncavitated) carious lesion within the confines of the fissure. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

Figure 3. A deep fissure area (arrow 1) and another area exhibiting a small light brown pit and fissure (arrow 2). Note that the lesion does not extend beyond the confines of the pit and fissure. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

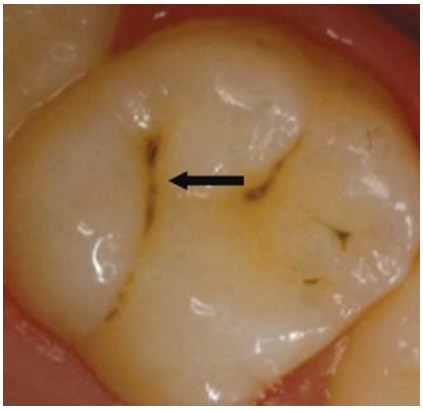

Figure 4. A more distinct early (noncavitated) carious lesion (arrow) that is larger than the normal anatomical size of the fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

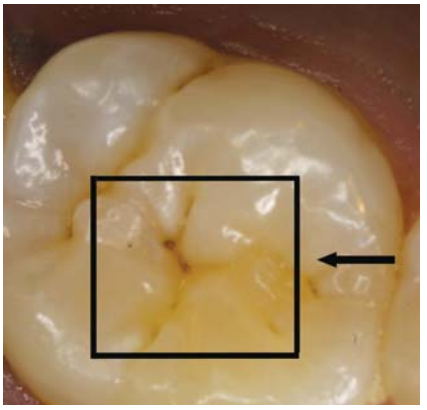

Figure 5. A more distinct early (noncavitated) carious lesion (arrow) that is larger than the normal anatomical size of the fissure area. Image provided courtesy of Dr. Amid I. Ismail, the Detroit Dental Health Project (National Institute of Dental and Craniofacial Research grant U-54 DE 14261-01).

options. The reader is referred to other resources for further discussion of caries risk.[88-94]

CLINICAL DETECTION OF NONCAVITATED PIT-AND-FISSURE CARIOUS LESIONS

Visual examination after cleaning and drying the tooth is sufficient to detect early noncavitated lesions in pits and fissures. The clinician should clean the tooth surface to remove debris and plaque before examining it for the presence of white demineralization lines or light yellow-brown discoloration surrounding the pit or fissure area. Noncavitated lesions also may appear as light to dark yellow-brown demineralization in the pit or fissure. It is important to note that external stain is not equivalent to a noncavitated carious lesion.

Figures 1 through 5 display examples of the range of lesions that are classified as noncavitated and indicated for sealing. All teeth in these figures were cleaned using a toothbrush and a periodontal probe or explorer before their surfaces were examined. Initially, the examiner (A.I.) conducted the examinations without drying the tooth surface. After determining that a visibly cavitated lesion was not present, the examiner dried the tooth surface with an air syringe to enable identification of early signs of dental caries.

The use of explorers is not necessary for the detection of early lesions, and forceful use of a sharp explorer can damage tooth surfaces.[89,95-97] The clinician should use recent radiographs, if available, in the decision-making process but should not obtain radiographs for the sole purpose of placing sealants. The Guide to Patient Selection for Dental Radiographs written by the ADA and the U.S. Food and Drug Administration[86] should be incorporated into the comprehensive care of the patient. There are many technologies that detect caries. Recent reviews suggest that these devices should be used only as adjunc-

tive devices to assist in caries diagnosis.[98,99] These devices should serve primarily as a support tool for making preventive treatment plan decisions in conjunction with caries risk assessment, and sole reliance on these devices to detect caries may result in premature restorative intervention.[98]

CONCLUSION

These evidence-based recommendations are a resource to be considered in the clinical decision-making process, which also includes the practitioner's professional judgment and the patient's needs and preferences. The recommendations address circumstances in which sealants should be placed to prevent caries, sealant placement over early (noncavitated) lesions, conditions that favor the placement of resin-based versus glass ionomer cement, and techniques to improve sealants' retention and effectiveness in caries prevention.

Pit-and-fissure sealants can be used effectively as part of a comprehensive approach to caries prevention. While sealants have been used for primary caries prevention, current evidence indicates that sealants also are an effective secondary preventive approach when placed on early noncavitated carious lesions. Caries risk assessment is an important component in the decision-making process, and it is important to re-evaluate a patient's caries risk status periodically. ■

Disclosure: None of the authors reported any disclosures.

The American Dental Association Council on Scientific Affairs and the expert panel thank the following people for their contribution to this project: Laurie Barker, MSPH, Centers for Disease Control and Prevention, Atlanta; Eugenio D. Beltrán-Aguilar, DMD, DrPH, Centers for Disease Control and Prevention, Atlanta; Susan Griffin, PhD, Centers for Disease Control and Prevention, Atlanta; Chien-Hsun Li, MS, MA, Centers for Disease Control and Prevention, Rockville, Md., and National Institute for Dental and Craniofacial Research, Bethesda, Md. They also thank members of the staff of the ADA Division of Science, Chicago: Daniel M. Meyer, DDS, senior vice president, science and professional affairs; Julie Frantsve-Hawley, RDH, PhD, director, Research Institute and Center for Evidence-based Dentistry; Helen Ristic, PhD, director, scientific information; Krishna Aravamudhan, BDS, MS, assistant director, laboratory professional product evaluations; Jane McGinley, RDH, MBA, manager, fluoridation and preventive health activities.

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