36 CHAPTER

Sealants

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Chapter Outline

As part of a complete preventive program, pit and fissure sealants are indicated for selected patients. Because topically applied fluorides protect smooth tooth surfaces more than occlusal surfaces, a method to reduce the incidence of occlusal dental caries is needed.

- The incidence of new pit and fissure caries can be lowered significantly by the application of adhesive sealants.
- Sealant application is a part of a complete prevention program, not an isolated procedure.
- As an isolated procedure, patient (and parent) may misunderstand the selected area of prevention that sealants represent. Other surfaces and other teeth still need other methods of preventive protection.
- **Box 36-1** provides definitions and terminology relative to sealants and their application.

DEVELOPMENT OF SEALANTS

Sealants were developed by Dr. Michael Buonocore and the group of dental scientists at the Eastman Dental Center in Rochester, New York.

- The focus of the early research was on the need to prepare the enamel surface so that a dental material would adhere.
- They demonstrated that by using an acid etch process, the enamel could be altered to increase retention.

BOX 36-1 Key Words

Pit and Fissure Sealants

Acid etchant: in sealant placement, the enamel surface is prepared by the application of phosphoric acid, which etches the surface to provide mechanical retention for the sealant.
Articulating paper: an inked ribbon held between teeth to determine tooth contacts.
Bibulous: absorbent; a flat bibulous pad, placed in the cheek over the opening of Stensen's duct, is used to aid in maintaining a dry field while placing sealants.
Biocompatibility: the ability of things to exist together without harm.
Bis-GMA: bisphenol A-glycidyl methylacrylate; plastic material used for dental sealants.
Bonding (mechanical): physical adherence of one substance to another; the adherence of a sealant to the enamel surface is accomplished by an acid-etching technique that leaves microspaces between the enamel rods; the sealant becomes mechanically locked (bonded) in these microspaces.
Bond strength: expression of the degree of adherence between the tooth surface and the sealant.
Conditioner: a substance added to another substance to increase its usability; in sealant placement, the acid etchant is added to the enamel to prepare it for bonding with the sealant.
Curing: the process by which plastic becomes rigid.
Incipient caries: beginning caries, caries limited to the enamel.
In vitro: under laboratory conditions.
In vivo: within the living body.
Micropores: tiny openings.
Polymer: a compound of high molecular weight formed by a combination of a chain of simpler molecules (monomers).
Polymerization: a reaction in which a high-molecular-weight product is produced by successive additions of a simpler compound.
  Photopolymerization: polymerization with the use of an external light source.
  Autopolymerization: self-curing; a reaction in which a high-molecular-weight product is produced by successive additions of a simpler compound; hardening process of pit and fissure sealants.
Sealant: organic polymer that bonds to an enamel surface by mechanical retention accommodated by projections of the sealant into micropores created in the enamel by etching; the two types of sealants, filled and unfilled, both are composed of Bis-GMA.
  Filled sealant: contains, in addition to Bis-GMA, microparticles of glass, quartz, silica, and other fillers used in composite restorations; fillers make the sealant more resistant to abrasion.
Viscosity: in general, the resistance to flow or alteration of shape by any substance as a result of molecular cohesion.

- The research proved to be a major breakthrough, particularly in esthetic and preventive dentistry.[1,2]

HOW SEALANTS WORK

I. DEFINITION

A pit and fissure sealant is an organic polymer (resin) that flows into the pit or fissure and bonds to the enamel surface mainly by mechanical retention when the acid etch process precedes the application of the sealant material.

II. ACTION

A. Purpose of the Sealant

- To provide a physical barrier to "seal off" the pit or fissure.
- To prevent oral bacteria and their nutrients from collecting within the pit or fissure to create the acid environment necessary for the initiation of dental caries.
- To fill the pit or fissure as deep as possible and provide tight smooth margins at the junction with the enamel surface.
- When sealant material is worn or cracked away on the surface around the pit or fissure, the sealant in the depth of the micropore can remain and provide continued protection while sealant material is added for repair and to reseal the enamel/sealant junction.

B. Purpose of the Acid Etch

- To produce irregularities or micropores in the enamel.
- To allow the liquid resin to penetrate into the micropores and create a bond or mechanical locking.
- **Figure 36-1** illustrates the sealant placed on a smooth enamel surface in contrast with placement on an etched surface with retention.

SEALANT MATERIALS

I. CRITERIA FOR THE IDEAL SEALANT[1]

1. Achieve prolonged bonding to enamel.
2. Be biocompatible with oral tissues.

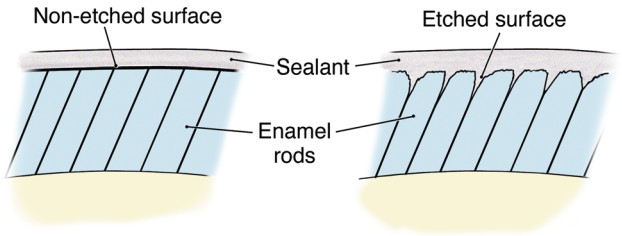

FIGURE 36-1 **Enamel–Sealant Interface.** Diagram of enamel–sealant interface to compare nonetched with etched surface. Etching produces microscopic porosities in the enamel to increase the area of retention. The unpolymerized resin flows into the porosities and hardens in taglike projections, as shown on the right. (Adapted with permission from Buonocore MG, Matsui A, Gwinnett AJ. Penetration of resin dental materials into enamel surfaces with reference to bonding. *Arch Oral Biol.* 1968 Jan;13(1):61–70.)

3. Offer a simple application procedure.
4. Be a free-flowing, low-viscosity material capable of entering narrow fissures.
5. Have low solubility in the oral environment.

II. CLASSIFICATION OF TYPES OF SEALANT MATERIALS

- A majority of sealants in clinical use are made of Bis-GMA (bisphenol A–glycidyl methylacrylate). The techniques of application vary slightly among available products.
- The three types of sealants currently available are filled, unfilled, and fluoride-releasing filled.
- Sealants are also identified by the method required for polymerization.

A. Classification by Method of Polymerization

1. *Self-cured or autopolymerized*
   - Preparation: material supplied in two parts. When the two are mixed they quickly polymerize (harden).
   - Advantages: no special equipment required.
   - Disadvantages: mixing required; working time limited because polymerization begins when the material is mixed.
2. *Visible Light–cured or photopolymerized*
   - Preparation: material hardens when exposed to a special curing light.
   - Advantages: no mixing required; increased working time due to control over start of polymerization.
   - Disadvantages: extra costs and disinfection time required for curing light, protective shields, and/or glasses.

B. Classification by Filler Content

1. *Filled*
   - Purpose of filler: To increase bond strength and increase resistance to abrasion and wear.
   - Fillers: Glass and quartz particles give hardness and strength to resist occlusal forces.
   - Effect: Viscosity of the sealant is increased. Flow into the depth of a fissure varies.
2. *Unfilled*
   - Clear, does not contain particles.
   - Less resistant to abrasion and wear.
   - May not require occlusal adjustment when placed, so at an advantage during school and community health programs where sealants are placed.
3. *Fluoride releasing*
   - Purpose: enhance caries resistance.
   - Action: remineralization of incipient caries at base of pit or fissure.

C. Classification by Color

- Available: clear, tinted, and opaque.
- Purpose: quick identification for evaluation during maintenance assessment.
- Effect: clear, tinted, or opaque sealants do not differ in retention.

INDICATIONS FOR SEALANT PLACEMENT

I. PATIENTS WITH RISK FOR DENTAL CARIES (ANY AGE)

- Xerostomia: from medications or other reasons.
- Patient undergoing orthodontics.
- Incipient caries (limited to enamel) and there is no radiographic evidence of caries on adjacent proximal surface.

II. TEETH

- Newly erupted: place sealant as soon after eruption as possible.
- Occlusal contour: when pit or fissure is deep and irregular.
- Caries history: other teeth restored or have carious lesions.

III. CONTRAINDICATIONS

- Radiographic evidence of adjacent proximal dental caries.
- Pit and fissures are well coalesced and self-cleansing; low caries risk.

IV. SELECTION OF TEETH

Figure 36-2 is a flowchart to assist in decision making.

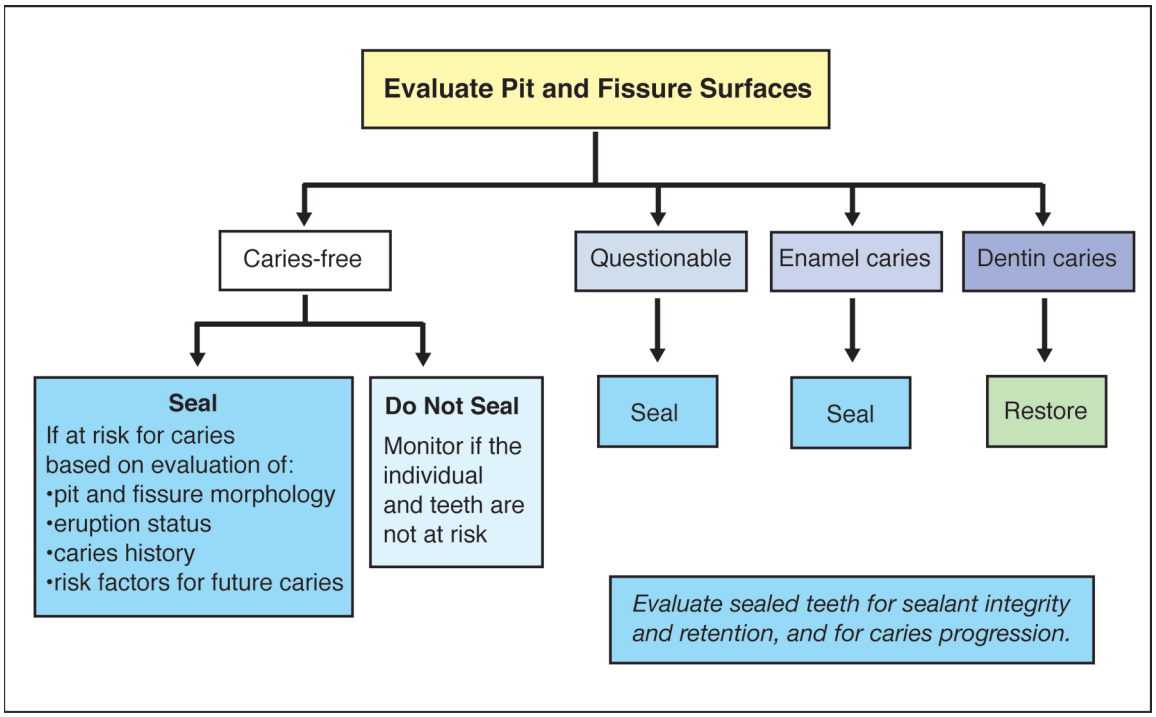

FIGURE 36-2 **Tooth Selection for Sealant Placement.** Flow chart to assist in decision making for placement of sealants. (Adapted with permission from Workshop on guidelines for sealant use: recommendations. The Association of State and Territorial Dental Directors, the New York State Health Department, the Ohio Department of Health and the School of Public Health, University of Albany, State University of New York. *J Public Health Dent.* 1995;55(5 Spec):263–73.)

CLINICAL PROCEDURES

I. GENERAL RULES

- Treat each quadrant separately.
- Use four-handed method with assistant
  A. To ensure moisture control.
  B. To work efficiently and save time.
- Follow manufacturer's directions for each product.
- Success of treatment (retention) depends on the precision in each step of the application.
- Retention of sealant depends on maintaining a dry field during etching and sealant placement.
- Steps in procedure: follow the outline in **Table 36-1**.

II. PATIENT PREPARATION

- Explain the procedure and steps to be performed.
- The patient must wear safety eyewear for both protection from the chemicals of etching and sealant, and also from the light of the curing lamp.

III. PREPARATION OF TOOTH

A. Purposes

1. Remove deposits and debris.
2. Permit maximum contact of the etch and the sealant with the enamel surface.
3. Encourage sealant penetration into the pit or fissure.

B. Examine the Surfaces: Remove Calculus and Stains

C. Patient With No Stain or Calculus

1. Request patient to brush; apply filaments straight into occlusal pits and fissures (Figure 27-14A).
2. Suction the pits and fissures with high-velocity evacuator.
3. Use explorer tip to dig out debris and bacteria from the pit or fissure.
4. Suction again to remove loosened material.
5. Evaluate for additional cleaning; the brushing may be sufficient.

D. Cleansing Procedure: Choices

1. Polishing cup and brush with pumice; low-speed handpiece.
   - Disadvantage: pumice particles become lodged in the pits and not rinsed out.
   - Alternative: use bristle brush with clear water.
2. Air-powder polisher.[3,4]
3. Rinse out thoroughly.

IV. ISOLATION

A. Purposes of Isolation

- Keep the tooth clean and dry for optimal action and bonding of the sealant.

TABLE 36-1 SEALANT APPLICATION PROCEDURES

PROCEDURE: WHAT TO DO	INSTRUMENTS AND EQUIPMENT: WHAT IS NEEDED
Preparation ■ Set up tray. ■ Seat patient comfortably. ■ **Debride** occlusal surface. ■ Use toothbrush, air-powder polisher device or prophy brush. ■ **Rinse** for 20–30 s. ■ **Evaluate** teeth to be sealed clinically **(Figure 36-2)**.	■ Safety glasses for the patient ■ Prophy angle and brushes, toothbrush, or an air-powder polishing unit ■ Mirror, explorer, and cotton pliers

Etching
■ **Isolate area.**
■ **Dry** area for 20–30 s with trisyringe.
■ **Etch** for 30–60 s.
  ■ Gel: brush on surface and leave in contact without disturbing it.
  ■ Liquid: cover surface and continue to keep surface wet by adding.
  ■ Do not rub.
■ **Rinse** until surface is free of etch.
  ■ Gel: 60 s
  ■ Liquid: 30 s
■ **Re-isolate area**
■ **Dry** for 20 s and check for chalky appearance.
■ *If not chalky, re-etch.*
	■ Isolation materials:
	  ■ Rubber dam setup or
	  ■ Cotton rolls and Garmer holders **(Figure 36-3)**, bibulous pads
	■ Brushes or cotton pellets to dispense
	■ Acid etch material (15–50%) phosphoric etch acid, additional etch throughout etch time
	■ Trisyringe
	■ High-speed suction
	■ Saliva ejector

Application
■ **Apply** sealant material.
  ■ Mix autopolymerized sealant material prior.
  ■ Light-cured needs no mixing.
■ **Cure** while maintaining a dry field.
	■ Sealant material
	■ Brushes or flow tubes or cannulas for placement to dispense sealant material
	■ Mixing sticks (if using self-cured)
	■ Material tray or waxed paper pad
	■ Ultraviolet safety glasses or shield for clinician
	■ Timer or watch with a second hand

Evaluation ■ Evaluate the placed sealant for voids and air bubbles ■ Add additional sealant if necessary. ■ Re-etch before placement of material if salivary contamination occurs. ■ Check occlusion with articulating paper, adjust if sealant interferes with occlusion. ■ Floss contact areas.	■ Articulation paper ■ Dental floss ■ Fluoride gel and trays
Follow-Up ■ Educate the patient. ■ Administer fluoride treatment. ■ Re-evaluate at each subsequent appointment.	

- Eliminate possible contamination by saliva and moisture from the breath.
- Keep the materials from contacting the oral tissues, being swallowed accidentally, or being unpleasant to the patient because of flavor.

B. Rubber Dam

- Rubber dam application is the method of choice because the most complete isolation is obtained. This method is especially helpful when more than one tooth in the same quadrant is to be sealed.
- Rubber dam is essential when profuse saliva flow and overactive tongue and oral muscles make retraction and consistent maintenance of a dry, clean field impossible.
- Combined treatment is planned. When a quadrant has a rubber dam and anesthesia for restoration of other teeth, teeth indicated for sealant can be treated.
- Use anesthesia when application of the clamp cannot be tolerated by the patient.
- Rubber dam may not be possible when a tooth that is essential for holding the clamp is not fully erupted.

C. Cotton-Roll Isolation

- Patient position: tilt head to allow saliva to pool on the opposite side of the mouth.
- Position cotton-roll holder (Garmer holder, **Figure 36-3**).
- Place saliva ejector.

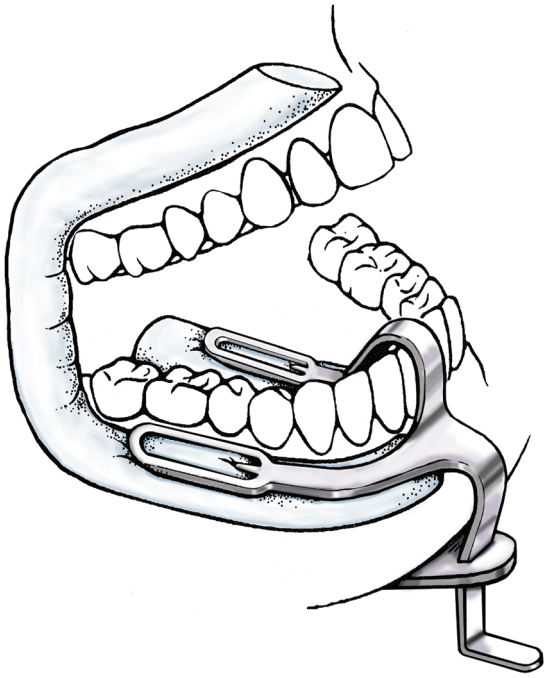

FIGURE 36-3 **Isolation Using Cotton-Roll Holders.** Two quadrants can be treated simultaneously. A continuous cotton roll extends from the mandibular anterior vestibule to the maxillary anterior vestibule. Bevel end of cotton rolls to facilitate retention. Lingual prong holds cotton roll adjacent to tongue over floor of the mouth.

- Apply triangular saliva absorber over the opening of the parotid duct in the cheek (bibulous pad).
- Take great care to prevent contamination from entering the area to be etched.

V. DRY THE TOOTH

A. Purposes

- Prepare the tooth for acid etch.
- Eliminate moisture and contamination.

B. Use Clean Air

- Clear the air by releasing the spray into a sink.
- Test for absence of moisture by blowing on a mouth mirror or other dry surface.

C. Time

- Air dry the tooth for at least 10 seconds.

VI. ACID ETCHING

A. Action

- Create micropores to increase the surface area and provide retention for the sealant **(Figure 36-1)**.
- Remove contamination from enamel surface.
- Provide antibacterial action.

B. Etch Forms

- *Phosphoric acid:* 15 to 50%, depends on product and manufacturer.
- *Liquid:* Low viscosity allows good flow into pit or fissure but may be difficult to control.
- *Gel:* Tinted gel with thick consistency allows increased visibility and control but may be difficult to rinse off the tooth surface.
- *Semi-gel:* Tinted, with viscosity between the gel form and the liquid allows good visibility, control, and rinsing ease.

C. Etch Timing

- Varies from 15 to 60 seconds. Follow manufacturer's instructions for each product.

D. Etch Delivery

- *Liquid etch:* Use a small brush, sponge, or cotton pellet; apply continuously throughout the etch time to keep the surface moist; do not rub, pat.
- *Gel and semi-gel:* use a syringe, brush, or manufacturer-supplied single-use cannula.

E. Completion of Etching

- Rinse thoroughly; apply suction to prevent saliva from reaching the etched surface.
- Dry, and examine the etched surface.
- Repeat etching process if the surface does not appear white and chalky.
- Dry for 15 to 20 seconds; maintain dry isolation ready for sealant application.

VII. SEALANT APPLICATION

A. Follow Manufacturer's Instructions

B. General Instructions

- Avoid overmanipulation to prevent producing air bubbles.
- Use disposable implement supplied for application.
- Cover all pits and fissures but do not overfill to a high, flat surface.
- After placement: leave in place for 10 seconds to allow for optimum penetration.

C. Curing

- *Timing:* 20 to 30 seconds in accord with manufacturer's instructions. Longer curing time is related to increased retention.
- *Apply curing light:* Use eye protection. Cover entire tooth surface to allow complete polymerization.
- *Check for voids:* Material can be added if surface has not been contaminated or wet.

VIII. OCCLUSION[5,6]

- Use articulating paper to locate high spots; adjust as required.
- Occlusal wear: unfilled sealants wear down to correct height; filled sealants require occlusal adjustment.

PENETRATION OF SEALANT

The penetration of a sealant depends on the following:

- The configuration of the pit or fissure
- The presence of deposits and debris within the pit or fissure
- The properties of the sealant itself

I. PIT AND FISSURE ANATOMY

A review of the anatomy of pits and fissures may be helpful in understanding the effects of sealants in the prevention of dental caries. The shape and depth of pits and fissures vary considerably even within one tooth.

- *Wide V-shaped* **(Figure 36-4B)** or *narrow V-shaped*.
- *Long narrow pits* and grooves reach to, or nearly to, the dentinoenamel junction **(Figure 36-4C)**.
- *Long constricted form with a bulbous terminal portion* **(Figure 34-4D)**. The pit or fissure may take a wavy course; it may not lead directly from the outer surface to the dentinoenamel junction.

II. CONTENTS OF A PIT OR FISSURE

A pit or fissure contains the following:

- Dental biofilm, pellicle, debris
- Rarely but possibly intact remnants of tooth development

III. EFFECT OF CLEANING

- The narrow, long fissures are difficult to clean completely.
- Retained cleaning material can block the sealant from filling the fissure and can also become mixed with the sealant.
- Removal of pumice used for cleaning and thorough washing are necessary for the success of the sealant.

IV. AMOUNT OF PENETRATION

- Wide V-shaped and shallow fissures are more apt to be filled by sealant **(Figure 36-5B)**.
- Although ideally the sealant penetrates to the bottom of a pit or fissure, such penetration is frequently impossible.
- Microscopic examination of pits and fissures after sealant application has shown that the sealant does not penetrate to the bottom because residual debris, cleansing agents, and trapped air prevent passage of the material **(Figure 34-5C** and **D)**.
- Incipient dental caries at the base of a well-sealed pit or fissure has no access to nutrients required for survival.

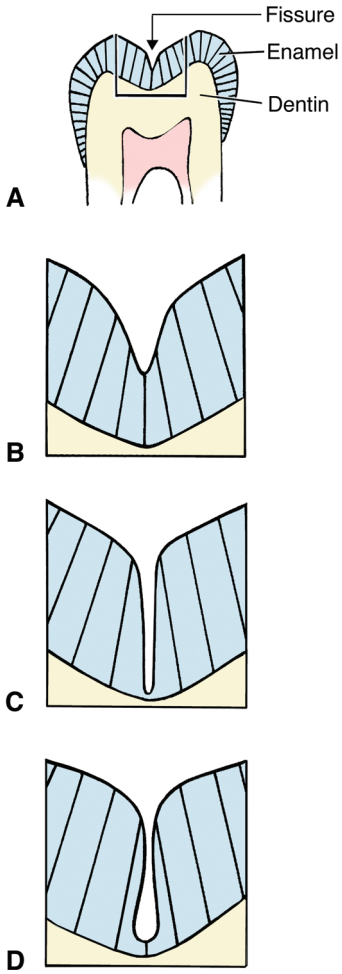

FIGURE 36-4 **Occlusal Fissures.** Drawings made from microscopic slides show variations in shape and depth of fissures. **(A)** Tooth with section enlarged for B, C, and D. **(B)** Wide V-shaped fissure. **(C)** Long narrow groove that reaches nearly to the dentinoenamel junction. **(D)** Long constricted form with a bulbous terminal portion.

MAINTENANCE

I. REEXAMINATION

At each maintenance appointment, or at least every 6 months, each sealant needs to be examined for deficiencies that may have developed.

II. RETENTION

A. Retention Time

- Sealants can be retained for many years.[7]
- Although surface sealant may be lost, sealant in the pits and fissures and sealant that penetrated into the microspaces of the enamel can still remain and provide some protection.[8]

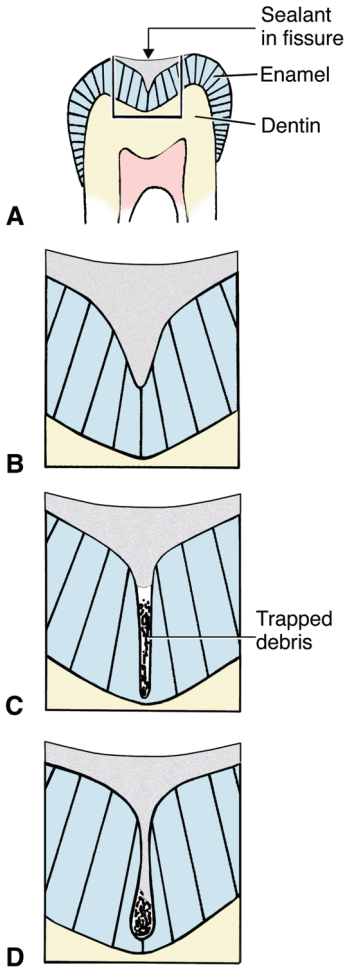

FIGURE 36-5 **Pit and Fissure Sealant in Fissures.** Drawings made from microscopic slides show extent to which sealant may fill a fissure. **(A)** Tooth with section enlarged for B, C, and D. **(B)** Sealant fills wide V-shaped fissure and extends a short way up the slopes of surrounding cusps. **(C)** and **(D)** Fissures partially filled as a result of narrow constriction of the groove and blockage by trapped debris.

B. Factors Affecting Retention

- *During placement:* precision of technique with exclusion of moisture and contamination.
- *Care of existing sealants.* Avoid using an air-powder polisher on intact existing sealants during maintenance appointments. Sealant wear increases with time of exposure to air-powder polisher abrasion.[9]

III. REPLACEMENT

A. Consult the manufacturer's instructions.
B. Tooth preparation: same as for original application.
C. Removal of firmly attached sections of retained sealant is not usually necessary.
D. Re-etching of the tooth surface is always essential.

DOCUMENTATION

Documentation in the record of a patient receiving a sealant needs to contain a minimum of the following:

- Reason for selection of certain teeth for sealants; informed consent of patient, parent or other caregiver.
- Type of sealant used, preparation of tooth, manner of isolation, patient cooperation during administration; post-insertion instructions given.
- A sample progress note may be reviewed in **Box 36-2**.

Everyday Ethics

Lillian had always enjoyed doing sealants when she was in dental hygiene school. They had been required to do quite a few, and as students they got to participate in "Sealant Day," a volunteer program carried out by the local dental hygienists every spring.

Now, when she came back from the state dental hygiene meeting, she was all excited about the new interpretation of the practice act by the Dental Board and greeted her employer, Dr. Fine, with the news the first thing Monday morning. The Board had voted that the dental hygienist who had been in practice for 2 years full-time (or part-time equivalent) could make the decision whether a pit or fissure needed a sealant. There was a continuing education course and an examination required.

Lillian added: "Remember Jack—that teenager that was here last week? He had some really deep fissures that I was sure would benefit from sealants. Can I go ahead and schedule him? I told him he needed them. He has an appointment with you to have a few cavities filled, but that wouldn't fit in your book until nearly the end of the month. They are giving the exam and CE next week."

Dr. Fine continued quietly to tie on his gown for the first patient, and then he smiled and said, "Well, Lil, let's wait until he comes in for his appointment with me and I'll look at them."

Questions for Consideration

1. Professionally, what action(s) can Lillian take to initiate a system of calibration between her and Dr. Fine to pursue the new practice protocols?
2. What ethical issues may be involved here? How can they be resolved?
3. Which of the core values describe the friendly relationship between Lillian and Dr. Fine? And which core values describe Lillian's wishes to extend the services for Jack's (the patient's) benefit?

BOX 36-2 Example Progress Note

Clara (age 9) scheduled for two sealants in occlusals of 3 and 30, very inquisitive and interested in what was going on. As I was getting ready she said "how long will these last? I answered they would last a very long time, at least until she is 25. She said 'this one down here (pointing to #30, "wasn't in very long—that's why Mom wants you to do it over." Shocked, I asked if the other person did it same as I am—she said "I dunno it didn't hurt anyway." *Told her* I was doing it a real special way, nice and dry—it should be perfect. (So I made a double effort to clean the pit and keep it dry with a cotton roll holder and saliva ejector.) Scheduled in a week for the other side.

Signed:_____, RDH Date:_____

Factors To Teach The Patient

- Sealants are part of a total preventive program. Sealants are not substitutes for other preventive measures. Limitations of dietary sucrose, use of fluorides, and dental biofilm control are major factors with sealants for prevention of dental caries.
- What a sealant is and why such a meticulous application procedure is required.
- What can be expected from a sealant; how long it lasts, how it prevents dental caries.
- Need for examination of the sealant at frequent, scheduled appointments, and need for replacement when indicated.

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