An investigation of pit and fissure sealant retention in 1,871 children in the Head Start program was conducted in Tennessee in September 1985 to determine the retention of the sealant after application to the occlusal surfaces of primary molars of 3- and 4-year-old children. The investigation shows pit and fissure sealants are retained on primary molars at a rate comparable to that expected on permanent molars.

Retention of pit and fissure sealant on the primary molars of 3- and 4-year-old children after 1 year

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Pit and fissure sealants have been an effective caries prevention material. Most studies regarding sealants have described their effectiveness on the permanent dentition.

In the primary dentition, children aged 5 through 9 years are estimated to average 5.3 decayed or filled surfaces (dfs) and 2.5 decayed or filled teeth (dfi), with children aged 5 having an average of 4.0 decayed or filled surfaces and 2.2 decayed or filled teeth. This suggests that the majority of tooth decay occurs shortly after eruption. There is scant information on the status of caries prevalence of the primary dentition of children younger than 5 years. Thus, data for caries susceptibility by tooth surfaces are not available for children with recently erupted primary molars.

However, the 1979-80 National Institute for Dental Research (NIDR) survey showed that 54% of caries in the permanent dentition occurred on the occlusal surfaces and 29% occurred on buccolingual surfaces. The National Preventive Dentistry Demonstration Program showed that 54% of permanent tooth caries occurred on the occlusal surfaces and 35% occurred on buccolingual surfaces. Based on these data, 83% to 89% of caries in the permanent dentition of children aged 5 to 17 years occurs in tooth surfaces with pits and fissures.

Although corresponding data for the primary dentition are not available, it may be inferred that the prevalence of caries by tooth surface for primary teeth with occlusal morphological structure similar to that of the permanent dentition approximates that of permanent teeth. If this inference is correct, then pit and fissure surfaces are at greater caries risk than smooth surfaces for both permanent and primary teeth.

As sealants are primarily used to prevent tooth decay in pits and fissures, it can be assumed that they are most effective in populations in which smooth surface tooth decay is under control. Because the majority of tooth decay occurs on the occlusal surfaces, sealants are one of the most important measures available in the prevention of tooth decay. When sealant application is coupled with the various methods of fluoride delivery, tooth decay can be almost eradicated in a target population. A recent study showed that early caries can be arrested by the application of sealant over affected tooth surfaces. Thus, the placement of sealant over existing incipient carious lesions is not a technique to be avoided, but may be considered an appropriate procedure for treating small lesions as well as a caries-preventive technique.

Early studies investigated the effectiveness of chemically cured and ultraviolet light-cured sealants. More recently, sealants that are polymerized by exposure to intense visible light have been introduced commercially, and reports indicate that 60% to 75% of sealants marketed are visible-light cured.

A sealant that is esthetically acceptable and easily detectable is desirable for both patient satisfaction and operator convenience. A detectable sealant enhances the application procedure and the ease of use.
identification at recall examinations.

Optimal benefits from sealants can be expected if the application is completed soon after the eruption of the tooth surface. Logistical problems are encountered when selecting a population of children with recently erupted primary teeth. One such population includes children enrolled in Head Start. Enrollees are 3 and 4 years old; their socioeconomic status places them in a high-caries-risk group, and they are readily accessible. Thus, children attending Head Start in Tennessee were eligible to participate in the study.

The purpose of this investigation was to evaluate the retention of an easily detectable, visible-light polymerized pit and fissure sealant after application to the occlusal surfaces of primary molars 6 to 24 months after eruption.

Materials and methods

Eligibility examinations were completed on 5,289 children by dentists employed by the Tennessee Department of Health and Environment. A mirror, explorer, and artificial light source were used for the dental examination; no radiographs were taken. Children with observed dental defects were referred for treatment. Children without dental treatment needs were considered eligible to participate in the program. An information sheet describing sealants and a parental consent form were sent home to be read, signed, and returned to the Head Start center.

During the 1984-85 academic year, 1,871 children received sealant. The application was completed by dentists and dental hygienists employed by the Tennessee Department of Health and Environment. Before the application phase of the project, each operator was requested to complete an 8-hour training program on pit and fissure sealant application.

The application procedure was conducted at the Head Start centers using portable dental equipment. On entering the dental treatment area, each child was seated in a portable dental chair to confirm eligibility to participate in the program. A fiberoptic dental operating light was used to illuminate the area of the mouth being examined and treated. The teeth designated for treatment were cleaned using a slurry of pumice and water and a rotating pointed prophylaxis brush. The pumice and debris were removed by washing the tooth surface thoroughly. The teeth were isolated by cotton rolls. The tooth surfaces to be sealed were dried with compressed air and etched for 60 seconds with a gel phosphoric acid etchant. The etchant was thoroughly washed from the teeth with water and aspirated from the mouth. The quadrants were reisolated with cotton rolls exercising care to prevent saliva contamination of the etched surfaces. The quadrant was dried for 15 seconds. A frosty or velvet appearance indicated an adequate etch, which if not present, indicated a need for the etching procedure to be repeated. A white, light-cured sealant was applied to the occlusal surfaces of second primary molars and selected first primary molars (those with well-defined pits and fissures) and polymerized for 20 seconds per surface with a visible-light curing unit. The sealed surfaces were examined for sealant imperfections and incomplete coverage; repairs were made as needed.

The time required to treat each patient was 20 to 30 minutes. An average of 10 patients were treated each day. Operators worked without dental assistants. To evaluate the retention of the sealant on the primary teeth, a group of children treated during the 1984-85 academic year were examined during the 1985-86 academic year.

To calculate the required sample size, an expected retention rate for primary teeth, based on results of a prior study (J. R. Hardison, personal communication, Tennessee Department of Health and Environment, 1984) of 91.1% was assumed. The sample size was calculated with a 95% confidence level. The assumption that the percentage of surfaces remaining sealed in the sample being ± 2.5% of the true percentage of primary teeth remaining sealed in the entire population was also used in the calculation. Systematic simple random sampling was used to select the Head Start centers included in this follow-up study. All children who had participated in the application phase of this sealant study and who were still attending one of the Head Start centers selected for the follow-up study were included in the sample. Follow-up examinations were completed during the academic year following the application phase of the project. Two operators, who were experienced in sealant examination procedures, completed the follow-up examinations. Occlusal surfaces were recorded as "sealed" if the sealant remained intact, "sealant partially missing" if only part of the sealant was intact, and "sealant missing" if no sealant was detectable.

The use of visibly detectable sealant enhanced the ease of the follow-up examination procedure. Follow-up examinations were conducted in four regions of the state. The χ² test designed to detect a significant difference in proportions was used to compare the percentages of surfaces that remained sealed at follow-up among the four regions. The same significance test was used to compare the overall results of this study with the 91.1% retention on primary teeth reported in a prior study.

Results

The condition of the occlusal surfaces at the follow-up examination is shown in Table 1. The overall retention rate was 88.2%. Sealant was completely missing from 10.6% of the surfaces sealed at the application phase of the project, and sealant was partially missing from 1.2% of the treated surfaces.

Metropolitan counties were not included in the follow-up study because of the potential for differences in application techniques between these counties, where operators were not trained in sealant application, and the remaining regions. The other regions that were not included in the follow-up study contained few Head Start centers and were not selected in the systematic sample selection. Teeth included in the follow-up study were all sealed in the 1984-85 application phase by operators who participated in the sealant application training program with the single exception of one operator in region 4.

Sealant retention by region is shown in Table 2. In regions 2, 6, and 8 sealant retention rates ranging from 92.5% to 96.3% were recorded. Twenty-six percent of the sealant was recorded as missing or partially missing from those surfaces treated in region 4. Each region was tested against the other regions to determine whether the retention of the sealant varied significantly.

These comparisons indicated that the retention of sealants on teeth in region 4 was significantly lower (P < .01) than the retention in each of the other three regions. The proportions of surfaces remaining sealed in regions 2, 6, and 8 were not significantly different from one another. The overall retention of 88.2% in this Head Start study was not significantly different from the 91.1% retention at 12 months found in an earlier study of sealant retention on primary surfaces.

Discussion

There is little doubt that sealed tooth surfaces remain impervious to dental caries for as long as the sealant remains intact. The success of sealants depends on their

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*Sum of percentages does not equal 100% because of rounding of figures.

Table 2 ■ Condition of occlusal surfaces at follow-up by region, Head Start Sealant Program, Tennessee, January 1986.
ability to remain firmly attached to the tooth surface, isolating the caries-vulnerable pits and fissures from the mouth. The sealant serves as a physical barrier, preventing caries-producing activities from affecting the sealed surface.

Early clinical reports of sealant application on primary teeth showed a lower rate of retention than on permanent teeth. Perhaps because of these early reports, many clinicians recommended that sealants be applied only to permanent teeth. Since the initial publications, studies have shown that comparable rates of retention can be accomplished for primary and permanent teeth. No special treatment, such as increasing the etching time from 60 to 120 seconds, is necessary when applying sealants to primary teeth.

One potential problem that existed in the minds of the Head Start Sealant Program planners was the ability of 3- and 4-year-old Head Start enrollees to cooperate for the duration of the application procedure, which was approximately 20 to 30 minutes. These fears proved unfounded as only approximately 5% of the children resisted or refused treatment.

The use of a white visible-light-cured sealant provides at least five advantages over a clear autopolymerized sealant. First, the sealant is easily detectable during application and at recall examinations. The likelihood of inadequate coverage or sealant imperfections such as surface bubbles is reduced. Second, the operator is in control of the polymerization time and need not be as concerned with environmental factors such as ambient temperature and humidity. Because the polymerization process begins immediately on application of the curing light, the problem of saliva contamination, which may be encountered while waiting for polymerization to occur when using autopolymerized materials is reduced. The third advantage of a visible-light-cured system is the reduction of polymerization time. Light-cured sealants are polymerized by a 20-second exposure to visible light; autopolymerized sealants require at least 60 seconds, and sometimes considerably longer depending on room temperature and humidity, for polymerization to be initiated. Fourth, the problem of an uneven distribution of the sealant over the tooth surface, when the patient is in a reclined position, is reduced by applying the curing light to the sealant immediately after application. The fifth advantage is the elimination of mixing the two components of the autopolymerizing system. This elimination saves time and reduces the need for a dental assistant, which is especially advantageous when ancillary personnel apply the sealant.

The application of the sealant in the Head Start centers provided an advantage in that it was not necessary to transport the children from familiar surroundings and place them in a dental office environment that could be interpreted as hostile. Portable dental equipment was placed in an area of the center where the children could easily watch the sealant application, thus alleviating patient apprehension that might be expected in children of this age group.

The sealant retention rates at follow-up examination ranged from 74.0% to 96.3% for the four regions involved in the follow-up (Table 2). Three of the four regions experienced retention rates of 92.5% or greater. Most of the operators participated in an 8-hour training program before the project, and some had previous sealant application experience. One operator did not attend the training program and had no application experience, which may be responsible for the lower rate of retention in region 4.

The retention rates observed in regions 2, 6, and 8 are comparable to the best reported retention rates on permanent teeth after 12 months.

Summary

A study investigating pit and fissure sealant retention on primary teeth of 1,871 children enrolled in the Head Start program was instituted in Tennessee in September 1985. The objective of the study was to determine the retentivity of sealant after application to primary molars with well-defined pits and fissures.

Children from four regions in Tennessee were reexamined 1 year after application to determine the rate of sealant retention. Regional retention rates varied from 74.0% to 96.3% with a total rate of 88.2% for all regions combined.

Sealant applied by experienced operators to primary teeth may be expected to be retained for periods comparable to retention times for permanent teeth.

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