

Screening preschool children for dental caries using a microbial test

Burton Edelstein, DDS, MPH Norman Tinanoff, DDS, MS

Abstract

The present report describes the usefulness of a microbial caries screening test in a population of children younger than 6 years. Two hundred children presenting to a private pediatric dental office were screened for *Streptococcus mutans* using a test adapted for the dental office. The numbers of *S. mutans* colonies were recorded semiquantitatively and carious lesions were assessed clinically and radiographically. Ninety-three per cent of children with caries were positive on the test (sensitivity), while 57% of the infected children had caries (specificity). Uninfected children were almost always caries free (predictive value negative 95%). The results also showed an increasing percentage of children with caries in groups of children with increasing infection level. These findings are consistent with both the central role of *S. mutans* in caries initiation and the multifactorial nature of caries development. The dramatically better results in the present report may reflect a closer correlation between caries activity and *S. mutans* infection in younger than in older children. Microbial screening may be useful for identification of young children infected with cariogenic microorganisms so that preventive and therapeutic treatments can be tailored to the needs of individual patients.

Developing a diagnostic test suitable for screening children with caries or at high risk of developing caries has been of interest for many years. Recent tests have focused on identifying the levels of *Streptococcus mutans* in plaque or saliva, since there is strong evidence that this microorganism plays a central role in the initiation and progression of caries (Loesche 1986).

Three methods commonly are employed to determine *S. mutans* infection level. The method of Westergren and Krasse (1978) utilizes stimulated saliva serially diluted and spread onto growth media selective for *S. mutans*. A dip-slide test developed by Jordan et al. (1987) utilizes stimulated saliva collected in a vial containing buffered saline and bacitracin. The diluted saliva is applied to a dip-slide coated with selective growth media. A method described by Kohler and

Bratthall (1979) utilizes stimulated saliva collected on a wooden spatula, which then is used to inoculate selective media directly.

While the presence of *S. mutans* is believed to be an essential prerequisite for caries initiation, dental caries is a multifactorial disease involving hygienic, dietary, and host resistance factors. These cariogenic factors must act for sufficient time to become expressed clinically as decalcification or cavitation. Since diagnostic tests based on microbiology measure only one of these several factors, it is expected that correlations between a microbiologic test and the presence of caries would be weak.

Nevertheless, studies have noted some association between caries incidence and high *S. mutans* counts. Klock and Krasse (1978) reported a low, but statistically significant correlation of $r = 0.2$ between numbers of salivary *S. mutans* and caries increment in 9- to 12-year-old Scandinavian children over a 24-month period. Kingman et al. (1988) noted that children, 10-15 years old, with low *S. mutans* levels developed 43% fewer lesions in a 17-month period than children with high counts. Steckslen-Blicks (1985) found high *S. mutans* counts in 67% of 8 year olds and 59% of 13 year olds who were caries active over a 12-month period, while low counts were identified in 74% of 8 year olds and 67% of 13 year olds who did not develop new lesions.

The potential for using microbiologic assays for diagnosis of caries activity in younger children may be higher than for older children. Very young children may or may not be infected (Carlsson et al. 1975) while older children are more likely to be infected with *S. mutans*. The early establishment of these microorganisms has been shown to indicate a high caries risk (Alaluusua and Renkonen 1983). The temporal relationship between infection and disease expression is short in younger children, increasing the likelihood that a microbial diagnostic test will correlate with disease. Furthermore, young children are less likely than older children to

have experienced dental treatment which may confound the relationship between microbial results and caries. The purpose of the present report is to examine the usefulness of a clinical microbial caries screening test when used in a population of children younger than age six.

Materials and Methods

The population consisted of 200 dentate children younger than the age of 6 years (mean 3 years, 8 months; range 5 months to 5 years, 11 months) who presented to a private pediatric dental office for an initial or recall visit. The only exclusionary criterion imposed was that the subjects must not have had any prior dental restorative care. The population from the dental practice was heterogeneous with respect to socioeconomic status, fluoride exposure, and presenting complaints.

During the initial visit each subject's saliva was sampled for *S. mutans* using the Caries Risk Test, a modification of the method of Kohler and Bratthall (1979). A sterile tongue blade was moistened with unstimulated saliva from each subject (Fig 1), then impressed onto the raised surface of a selective culture medium (Fig 2). The selective medium, mitis salivarius bacitracin (Gold et al. 1973), was modified so that the bacitracin could be applied to the surface of the medium. This was accomplished by preparing a bacitracin solution from 2, 10-unit bacitracin disks (BBL) dissolved in 1 ml sterile water and spreading the solution onto the medium with a sterile cotton swab.

Plates were inoculated with saliva and incubated at 35-37° C in plastic bags inflated with expired air to enhance environmental CO₂. After 2 days the plates were visually inspected for the presence of bacteria morphologically resembling *S. mutans*, i.e., dark, discrete, raised colonies (Coykendall 1977). The number of colonies were recorded semiquantitatively as zero, low (1-9), moderate (10-99), or high (> 100).

For the purposes of this project, caries status was assessed retrospectively by reviewing clinical examination records of the participating pediatric dentists. As was customary in this practice, visual examinations were supplemented with radiographs when necessary to visualize proximal contact areas.

The presence of caries from the clinical examinations was compared to the presence of *S. mutans* on the Caries Risk Test by Chi-square analysis. The ability of the test to reflect the caries status of children was evaluated in two ways. Given the caries status of children the test was assessed on its ability to identify those children infected with *S. mutans* (sensitivity and specificity). Given the infection status of the children based on the test, the children were assessed for the presence or absence of

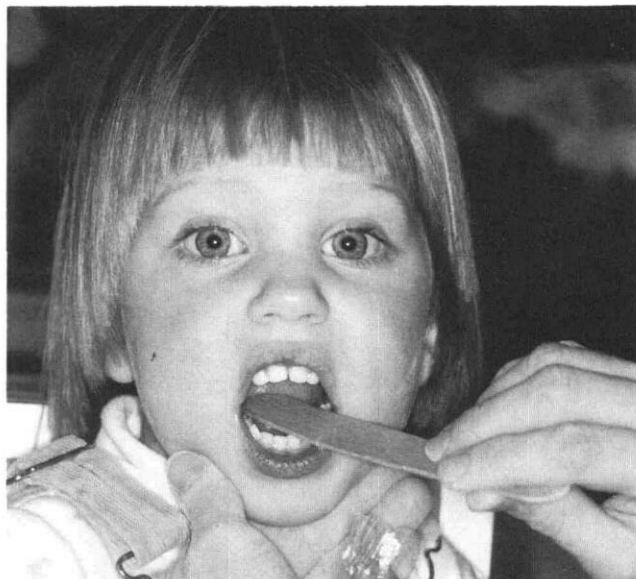


FIG 1. A sterile tongue blade, wetted with saliva, is used to obtain the bacterial sample from the oral cavity.

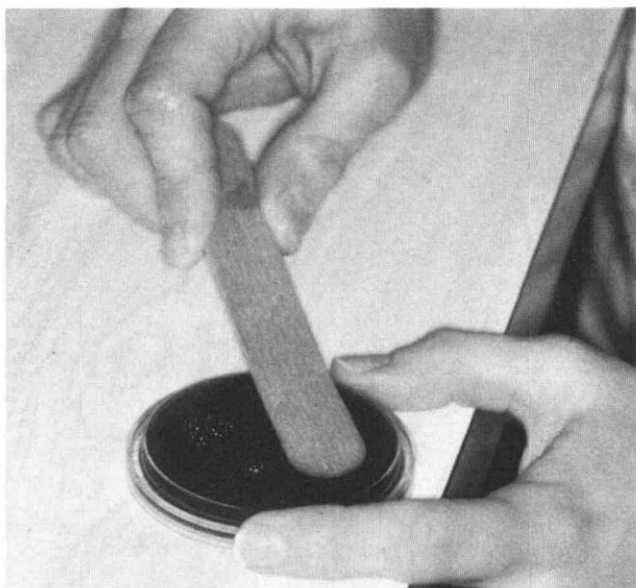


FIG 2. The tongue blade is impressed onto the raised surface of a selective culture medium. After 2 days' incubation, the numbers of *S. mutans* are counted.

caries at the time of testing (predictive values positive and negative).

Results

Of the 200 children younger than age 6 presenting for examination, 61 (30.5%) were identified as having caries detectable by visual or radiographic findings. The microbial screen found 117 (58.5%) children to have at least 1 bacterial colony identified as *S. mutans* (Table 1, next page). The correlation between caries and the

TABLE. Distribution of Children With and Without Clinical Caries

Caries	Caries Risk Test				
	-	79	60		139
	+	4	57		61
		83	117	200	

$\chi^2 = 52.93, P < .001.$

presence of *S. mutans* was highly significant (Chi-square = 52.93; $P < .001$).

When the data were stratified by log of the numbers of colonies on the Caries Risk Test, the results showed an unbroken trend relating increasing numbers of *S. mutans* with increasing percentages of caries-positive children (Fig 3). The correlation between caries and stratified microbial counts was also highly significant (Chi-square = 88.46; $P < .001$).

Children with caries were almost always positive on the test (sensitivity 93.4%; 57/61). Approximately half the children without caries were negative on the test (specificity 56.8%; 79/139). Children negative on the microbial test had little chance of having caries at the time of testing (predictive value negative 95.2%; 79/83) while approximately half of the children positive on the test demonstrated caries at the time of testing (predictive value positive 48.7%; 57/117). The percentages of false negatives and false positives were 2% (4/200) and 30% (60/200), respectively.

Discussion

The current findings are consistent with both the central role of *S. mutans* in caries initiation and the multifactorial nature of caries development. Almost all caries-positive children in the present study were found to be infected with *S. mutans* while uninfected children were almost always caries free. Interestingly, 3 of the 4 children with caries who were not infected were found to be taking antibiotics at the time of culture. Exclusion of these subjects yields a sensitivity of 98.4%.

The presence of *S. mutans* in the saliva of children with caries was expected since infection is believed essential for caries initiation. Because caries is multifactorial, however, not all infected children are expected to have caries. Approximately half the children positive on the Caries Risk Test did have caries (48.7%) while the remaining infected children are known to maintain at least 1 essential component of the caries process and may therefore be considered at higher caries risk than uninfected children.

The percentage of infected children with caries and the percentage of noncarious children without infection are dramatically higher than previously reported. This

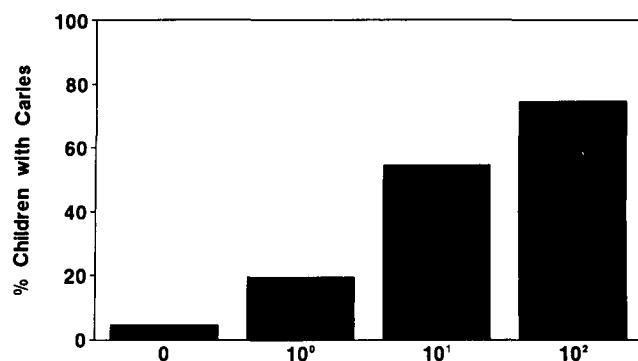


FIG 3. Percentage of caries-positive children in groups of increasing *S. mutans* infection level.

finding may be due to the population selected, children younger than age 6 with no prior restorative treatment. Better correlation between *S. mutans* infection and clinical caries in young children has been suggested previously. Kohler et al. (1984) found that in 3-year-old children only 1 out of 34, who had clinically detected caries, did not harbor *S. mutans*. Alaluusua and Renkonen (1983) reported that children will be most caries active if *S. mutans* infection is found before age 2.

Testing children for infection with cariogenic microorganisms is not currently a routine diagnostic procedure. The most accepted *S. mutans* assay, the micromethod of Westergren and Krasse (1978), requires laboratory dilution and plating procedures which cannot be accomplished in a dental office. The Caries Risk Test can be performed easily in a dental office by personnel with little expertise. The plates, although presently not commercially available, are relatively inexpensive to produce. Caries Risk Test also has advantages over other *S. mutans* tests in that it does not require children to produce stimulated saliva. Our experience has been that most children younger than age 6 are not able to expectorate into a tube or funnel.

The usefulness of this test in screening young children for caries is based upon the essential role of *S. mutans* in caries initiation. A positive finding on the microbial test denotes a child who is caries competent and who may or may not demonstrate clinical disease at the time of screening. A negative finding on the test denotes a child who does not have one of the etiological requisites for caries and may therefore be considered caries incompetent. The caries competent child may be at higher risk for caries than the caries incompetent child. However, longitudinal studies are required to assess the usefulness of the test in anticipating the development of clinical lesions.

This screening test may be of particular use to the clinician who seeks to distinguish the caries competent young child from the caries incompetent young child both of whom appear caries free on examination. Such

distinction allows the clinician to decide rationally on preventive therapies tailored to a patient's level of risk, including frequency of recalls, provision of antimicrobial medications, and intensity of preventive counseling.

Dr. Edelstein is a clinical instructor and Dr. Tinanoff is a professor, pediatric dentistry, University of Connecticut School of Dental Medicine. Reprint requests should be sent to: Dr. Burton Edelstein, 190 Hempstead St., New London, CT 06320.

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Caution with children's medicines

Children with seizures, congenital heart disease, or recurrent infections often receive large quantities of oral liquid medicines, usually sweetened with 30-50% sugar.

Physicians and dentists have no choice but to prescribe such medication to very small children, since sugar-free versions of medicines such as penicillin, digoxin or phenobarbital are not available. Furthermore, these children are unable to take medicine in pill form, so it usually dispensed by dropper or spoon directly into the mouth.

A Canadian study found that children having medical problems during the early years were also diagnosed as having severe decay to the primary teeth. Researchers found that parents often gave the oral medicine to their children just before naptime. Teeth were not brushed frequently because the children were often sickly or cranky, or the parents were too busy dealing with the management of the child's medical problem. Dentists should make parents aware of this problem and suggest the following:

1. If your child has a medical problem that requires periodic use of oral liquid medications, consult a dentist immediately so a preventive program can be instituted. This should begin as soon as the first tooth erupts.
2. If your child is on oral liquid medications now, check inside the upper incisor teeth for any discoloration. If it is noted, take your child to a dentist immediately.
3. Try to arrange drug dosages for times when the child is awake. Try to eliminate the practice of squeezing liquid medication into the mouth of a sleeping child. The sugar-laden medication will not be diluted, since normal saliva flow is decreased during sleep.
4. Write to pharmaceutical companies that supply the drugs your child has to take, and ask them to supply the drugs your child has to take, and ask them to supply you with the medication in a sugar-free solution.

Tables containing the sweetener content of common pediatric medications can be found in the January 1988 issue of the *American Journal of Hospital Pharmacy*.