ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

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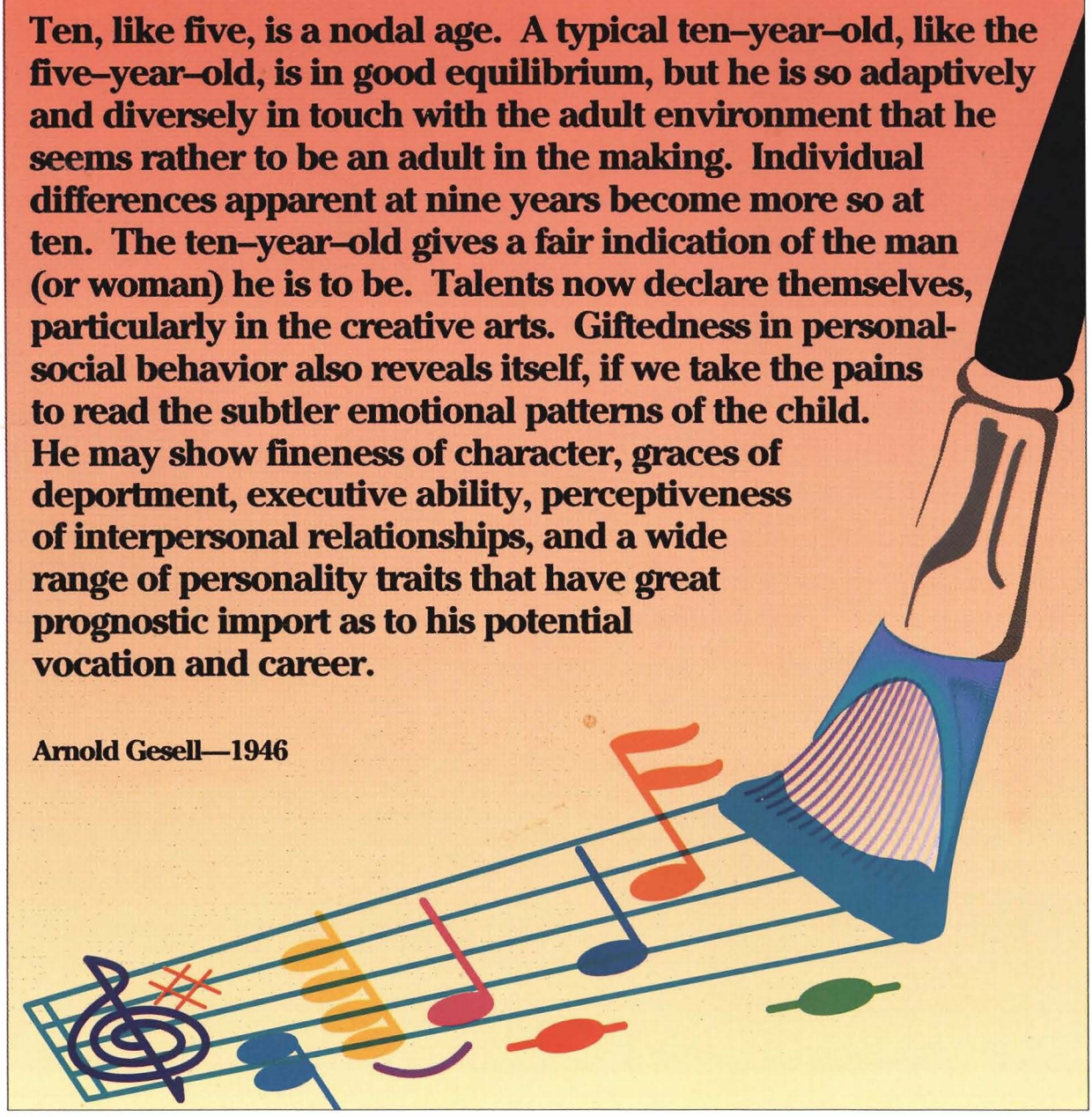
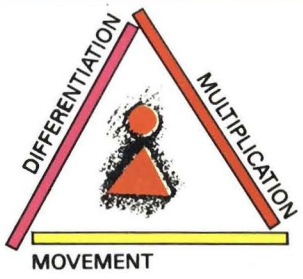
JOURNAL OF DENTISTRY FOR CHILDREN

Ten, like five, is a nodal age. A typical ten–year–old, like the five–year–old, is in good equilibrium, but he is so adaptively and diversely in touch with the adult environment that he seems rather to be an adult in the making. Individual differences apparent at nine years become more so at ten. The ten–year–old gives a fair indication of the man (or woman) he is to be. Talents now declare themselves, particularly in the creative arts. Giftedness in personal-social behavior also reveals itself, if we take the pains to read the subtler emotional patterns of the child. He may show fineness of character, graces of deportment, executive ability, perceptiveness of interpersonal relationships, and a wide range of personality traits that have great prognostic import as to his potential vocation and career.

Arnold Gesell—1946



THROUGH OUR GREAT FORTUNE,
IN OUR YOUTH OUR HEARTS
WERE TOUCHED WITH FIRE.
—Oliver Wendell Holmes, Jr.



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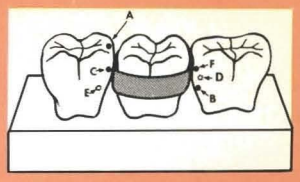

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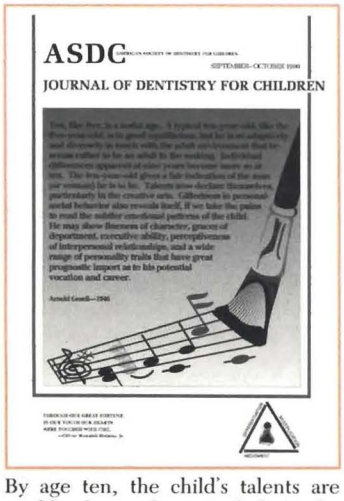

By age ten, the child's talents are readily observed, particularly in the creative arts. To be discovered are fineness of character, graces of deportment, and perceptiveness of interpersonal relations, among others. Cover art and design by Sharlene Nowak-Stellmach.

PREVENTION

SPEECH ARTICULATION

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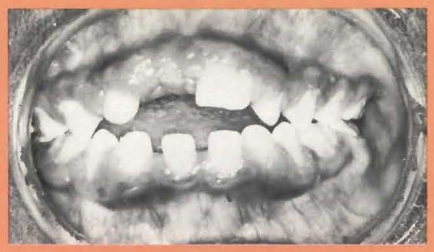

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CLINIC

DEMOGRAPHY

For the busy reader

Prevalence of *Streptococcus sobrinus* in relation to dental caries in children from Iceland and The Netherlands—page 337

As *S. sobrinus* has been determined to be the most acidogenic mutans streptococcus in the human mouth, it could have cariogenic potential in man. Iceland has the highest prevalence of caries reported in Europe; *S. sobrinus* was found to be prevalent in a population of nine-year-olds there. A Dutch study suggested a relationship between *S. sobrinus* and proximal caries. Results of this study suggest that *S. mutans* and *S. sobrinus* may have different roles in the etiology of dental caries.

Requests for reprints should be directed to Dr. J.J. de Soet, Department of Oral Microbiology, van den Boechorststraat 7, 1081 BT, Amsterdam, The Netherlands.

Use of fluoride supplementation by children living in fluoridated communities—page 343

The purpose of this descriptive epidemiological study was to determine the percentage of inappropriate supplementation among schoolchildren (from Massachusetts and Connecticut), who either displayed mild-to-moderate dental fluorosis or were fluorosis-free. Fluoride supplements were incorrectly prescribed for a significant percentage of children who were living in fluoridated areas during the first six years of life, resulting in an increased frequency of enamel fluorosis cases.

Requests for reprints should be directed to Dr. David G. Pendrys, Department of Behavioral Sciences and Community Health, University of Connecticut School of Dental Medicine, Farmington, Connecticut 06032.

Pits and fissures: remnant organic debris after acid-etching— page 348

The two most important factors in obtaining a clean enamel surface receptive to the sealant material are the removal of surface debris and pellicle, and the quality of the etched surface. The aim of this study was to determine whether etches remove additional debris after prophylaxis; and to examine and compare the efficacies of a liquid and a gel etchant.

Requests for reprints should be directed to Dr. Michael F. Burrow, Department of Dentistry, The University of Adelaide, G.P.O. Box 498, Adelaide, South Australia 5001.

***In vitro* fluoride uptake by enamel adjacent to a glass ionomer luting cement—page 352**

The reduced incidence of caries along margins of some restorations has been documented. When used as a restorative material, glass ionomer cements release fluoride at a constant low level—possibly offering protection to the entire tooth.

Requests for reprints should be directed to Dr. John O. Burgess, 3118 Whisper Brook, San Antonio, TX 78230.

Tongue skills and clearance of toffee in two age-groups and in children with problems of speech articulation—page 356

During the chewing and swallowing of sticky food such as toffee and the subsequent scavenging of particles lodged between the teeth and in areas such as the buccal sulcus, the tongue executes highly coordinated, precise movements. These are made possible by the highly developed feedback from tactile, pressure, and stretch receptors in the tongue. Sensory acuity, as tested by oral stereognosis, improved with age, confirming previous reports. Speech-impaired children are at high risk for dental caries if they regularly eat sticky, fermentable carbohydrates.

Requests for reprints should be directed to Dr. Speirs, Physiology Department, The London Hospital, Medical College, London E1 2AD, United Kingdom.

Subjective signs of efficacious inferior alveolar nerve block in children—page 361

Difficulty in obtaining inferior alveolar nerve block (IANB) in children has been reported for several reasons. A long buccal nerve block injection immediately afterwards can superimpose clinical signs as if from the IANB. There is cross-innervation by the mylohyoid

nerve. Also, the mandibular foramen changes position with age, which is not always recognized. It is recommended that the clinician use the gingival sign test to determine adequacy of IANB before other injections are made, and before treatment is begun.

Requests for reprints should be directed to Dr. Joel H. Berg, Associate Professor, Department of Pediatric Dentistry, The University of Texas Dental Branch, 6516 John Freeman Avenue, Houston, TX 77030.

Chlorhexidine as an oral hygiene adjunct for cyclosporine-induced gingival hyperplasia—page 366

Immunosuppressive therapy has contributed greatly to the success of organ transplants; one of the major drugs is cyclosporine, which can cause gingival overgrowth. Although chlorhexidine appears to be the controlling factor in the diminution of the hyperplastic response described in this report, it is obvious that there were several potentially confounding variables.

Requests for reprints should be directed to Dr. Mario E. Saravia, Assistant Professor, Department of Pediatric Dentistry, MCV School of Dentistry, Box 566, Richmond, VA 23298-0566.

Assessment of a 2 percent buffered glutaraldehyde solution in pulpotomized primary teeth of schoolchildren—page 371

Glutaraldehyde has been proposed as a possible substitute for formocresol after pulpotomies in primary teeth. Because it is a fixative, its effect is similar to that of formocresol; it is believed to be less toxic, however. The efficacy of this medicament was demonstrated in human clinical trials. The relatively high failure rate (18 percent) observed in this study does not justify recommending it as a substitute for formocresol. Using different concentrations, times, an/or application means might produce better results.

Requests for reprints should be directed to Dr. Anna B. Fuks, Hadassah Faculty of Dental Medicine, Department of Pedodontics, P.O. Box 1172, Jerusalem, Israel.

Clinical and histologic findings of the dentition in a hypopituitary patient: report of case—page 376

Idiopathic hypopituitarism is associated with delayed dental eruption as well as delayed growth of the dentofacial complex. Both maxillary and (especially) mandibular growth can be affected. The clinical dental findings and histologic findings related to enamel maturation in the permanent dentition of a teenaged male with a hypopituitary condition are described.

Requests for reprints should be directed to Dr. William H. Hoffman, Section of Pediatric Endocrinology, Department of Pediatrics, Medical College of Georgia, Augusta, GA 30912.

Are minority children getting their fair share of dental services?—page 380

Requests for reprints should be directed to Dr. Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

Selecting a location for the practice of pediatric dentistry— page 385

Requests for reprints should be directed to Dr. Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

Prevalence of *Streptococcus sobrinus* in relation to dental caries in children from Iceland and The Netherlands

Prevention

J.J. de Soet, PhD
W.P. Holbrook, PhD
W.E. van Amerongen, PhD
E. Schipper
C.H.E. Homburg
J. de Graaff, PhD

In a previous study, we reported that *Streptococcus sobrinus* was the most acidogenic mutans streptococcus resident in the human mouth.[1] Consequently, this species might be cariogenic in man. The relationship of *S. sobrinus* and caries is relatively easy to study in a population with a high caries prevalence. Iceland has the highest prevalence of caries reported in Europe in recent years and is very suitable, therefore, for such studies.[2] Moreover, *S. sobrinus* has been found to be prevalent in a population of nine-year-old children in Iceland.[3] *S. sobrinus* has also been isolated primarily from caries-active children in a longitudinal study done in Iceland.[4] A relationship between the presence of *S. sobrinus* and proximal caries was suggested in a study done in The Netherlands.[5] It was shown that conventional cultural methods on selective media underestimate the numbers of *S. sobrinus* in oral samples.[6] Identification of this species is laborious and time-consuming, and consequently epidemiological studies relating bacteria to caries rarely report specifically on the

Drs. de Soet, Schipper, Homburg, and de Graaff are in the Department of Oral Microbiology and Dr. van Amerongen, Department of Pediatric Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), van den Boechorststraat 7, 1081 BT Amsterdam, The Netherlands. Dr. Holbrook is on the Faculty of Odontology, University of Iceland, Reykjavik, Iceland.

presence of *S. sobrinus*.[1] *S. sobrinus* colonies are often identified as "*S. mutans*", thus underestimating *S. sobrinus* and overestimating *S. mutans*. Recently, reliable methods for detecting *S. sobrinus* and *S. mutans* with monoclonal antibodies (Mabs) have been developed and made suitable for use in epidemiological studies of caries prevalence.[7] The aim of this study was to investigate the presence of *S. sobrinus* and *S. mutans* in specimens of dental plaque and saliva of children five years of age in Reykjavik, Iceland and in samples of dental plaque from children nine years of age in Amsterdam. The microbiological findings in both countries could then be compared with the respective clinical data, in order to learn more of the possible role of *S. sobrinus* in dental caries. The results presented here are baseline data of a longitudinal study.

MATERIALS AND METHODS

Study 1: Iceland

This investigation formed part of a longitudinal study of factors associated with dental caries among preschool children in Reykjavik. Data collected at the beginning of the study have been reported.[8] Of the original 148 children who entered the study, 125 returned for reexamination after five years. At this visit dental caries was scored as previously described and by the same operator.[8] Subjects were asked to chew a piece of sugar-free gum in order to stimulate salivation. Approximately 1 ml of whole saliva was collected in a sterile test tube. A dental plaque sample was collected using sterile interdental wooden sticks inserted once between the first and second primary molars in the third quadrant, or when absent, in the fourth. Saliva samples were diluted 100-fold and plaque samples 10-fold. These diluted samples were used to inoculate plates of MSB agar, TYCSB agar and blood agar on to which a nitrocellulose membrane (Schleicher & Schüll, BA85, 0.45μM pore size) was previously placed.[9,10] An inoculum of 100 μl was spread over the surface of the medium using a sterile loop drawn slowly across the medium as the plate rotated (Denley rotary plater, Denley, Sussex, England).

All plates were incubated for two days in a candle jar at 37°C. Counts of colonies resembling *S. mutans* were made from TYCSB plates. Attempts were made to count separately colonies with a surrounding "halo" in TYCSB medium and these were presumptively identified as *S. sobrinus*.[10] The nitrocellulose membranes were peeled off the blood agar and dried at 80°C for thirty minutes. Then they were incubated with phosphate buffered saline (PBS) supplemented with 0.05 percent (v/v) between 80 and 1 percent (w/v) bovine serum albumin, and agitated gently for 1 hour in this solution, dried and mailed to the laboratory in Amsterdam for further treatment.

Immuneblotting technique (IBT)

The nitrocellulose membranes were washed in 1 percent bovine serum albumin in PBS supplemented with 0.05 percent between 80 and 0.001 percent Merthiolate (PBST) for thirty minutes at room temperature (RT). To check for microorganisms that are (cross-)reactive with second antibodies, the membranes were incubated with goat antimouse immunoglobulins (affinity purified, horseradish peroxidase conjugated (Bio-Rad 170-6516, Richmond, VA USA), 1:1500 diluted in PBST) at RT for two hours. After five wash steps with PBST of five minutes each, a chloronaphthol staining procedure was performed (50 mg chloronaphthol in 20 ml ethanol 96 percent, 80 ml sodium citrate (10mM, pH = 5.5) and 40μl H_2O_2 30 percent. The positive dots were marked on a transparent sheet. To identify *S. sobrinus* colonies, the membranes were washed once with PBST and incubated with a Mab OMVU10 against *S. sobrinus* at RT for sixteen hours. After three wash steps with PBST, the adherence of the Mabs to the bacteria was made visible with a second antibody incubation and a staining procedure as described above. The new stained dots that corresponded with *S. sobrinus* colonies on the nitrocellulose membrane, were marked on the same transparent sheet as used before. The IBT was continued with a Mab against *S. mutans*, OMVU31. The adherence of this Mab was detected as described for OMVU10. After the detection of these *S. mutans*-positive colonies, a final incubation step with a Mab against all mutans streptococci, OMVU2, was performed.

Study 2: Amsterdam

The presence of caries and proximal caries was scored by one calibrated operator using a mirror and probe in a group of seventy-two nine-year-old children in Amsterdam. The criteria used in this study were adapted from those of the W.H.O.[11] The children were visiting the same school in Amsterdam. The group consisted of more than 90 percent immigrant-children.

Dental plaque samples were removed with a U-15 scaler from the smooth surfaces of one of the first molars and from teeth where proximal caries or smooth surface caries was suspected. The samples were diluted

in Todd Hewitt broth (Oxiod, Basingstoke, Hants, England) and immediately plated on TYCSB plates using a spiral plater (Spiral Systems Inc., Lameris). Plates were incubated at 37°C, anaerobically (80 percent N_2, 10 percent H_2 and 10 percent CO_2) for four days and screened for the presence of colonies with a surrounding "halo" in the medium. Such colonies were presumptively identified as *S. sobrinus*.[10]

Stimulated saliva was collected after chewing on a piece of paraffin wax. The salivary flow-rate and the buffer-capacity were measured with the Dento-Buff system (Orion Diagnostics, Finland).

RESULTS

The IBT was a suitable method to evaluate the presence and the numbers of *S. mutans* and *S. sobrinus* in human dental plaque and saliva. An example of a nitrocellulose membrane after the IBT procedure is shown in Figure 1. Because of difficulties due largely to transport between laboratories, only eighty-four from Iceland were successfully treated in Amsterdam.

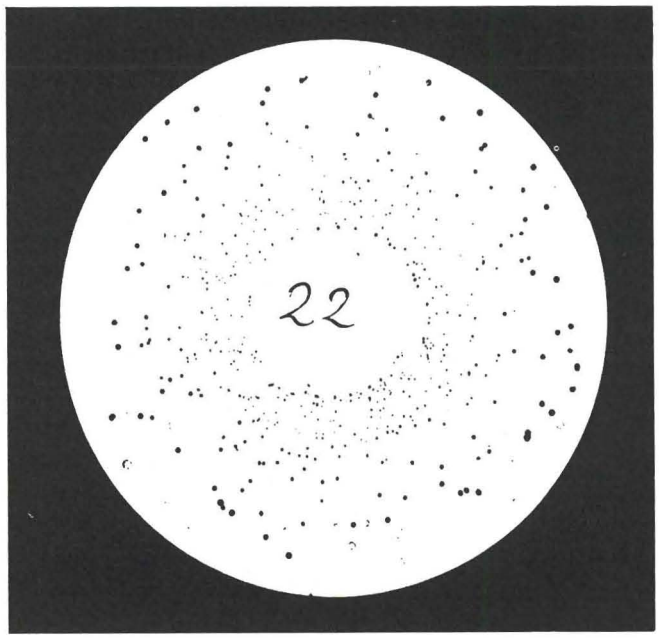

Figure 1. An example of a plaque sample, cultured on a nitrocellulose membrane and stained with the IBT procedure.

Study 1: Iceland

CARIES PREVALENCE

The mean decayed, missing, and filled teeth (DMFT) of the five-year-old children was 2.9 (S.E. 0.26). For the same subjects at four years of age, the mean DMFT was 2.4 (S.E. 0.29). The caries increment was not evenly spread across all children: 39 percent remained caries-free at five years, whereas 30 percent had developed proximal caries.

BACTERIAL FINDINGS

Of the eighty-four children examined bacteriologically, 73 percent harbored mutans streptococci in their plaque or saliva. *S. sobrinus* was present in plaque or saliva samples from 29 percent of the children. Table 1 shows the numbers of plaque or saliva samples that contained mutans streptococci with reference to whether caries or proximal caries was detected.

Stepwise multiple regression analyses, using caries or proximal caries as dependent variables, suggested an association, but not significant, between *S. sobrinus* in dental plaque and proximal caries ($p = 0.02$, $r = 0.5$) and between the DMFT and *S. mutans* in saliva ($p = 0.05$, $r = 0.2$). The counts of mutans streptococci from tongue loops on MSB were significantly lower, however, if the DMFT was also low ($p < 0.001$, chi-square; Figure 2).

Table 1 □ Cross-tabulation of the bacterial findings from plaque and saliva in relation to the presence of caries and proximal caries from children in Iceland.

	S. mutans				S. sobrinus		
Plaque (CFU/sample)	0	$1\text{-}10^2$	$10^2\text{-}10^3$	$>10^3$	0	$1\text{-}7.10^2$	$>7.10^2$
Caries absent N = 43	11 (25)	14 (33)	13 (30)	5 (12)	32 (74)	5 (12)	6 (14)
Caries present N = 41	11 (27)	7 (17)	17 (41)	6 (15)	31 (76)	5 (12)	5 (12)
Prox. absent N = 60	16 (27)	16 (27)	19 (31)	9 (15)	45 (75)	8 (13)	7 (12)
Prox. present N = 24	6 (25)	5 (21)	11 (46)	2 (8)	18 (75)	2 (8)	4 (17)
Saliva (CFU/sample)	0	$1\text{-}10^3$	$10^3\text{-}10^4$	$>10^4$	0	$1\text{-}10^3$	$>10^3$
Caries absent N = 43	11 (28)	16 (38)	13 (30)	4 (9)	33 (77)	4 (9)	6 (14)
Caries present N = 41	8 (20)	14 (34)	15 (37)	4 (9)	30 (73)	4 (10)	7 (17)
Prox. absent N = 60	15 (25)	22 (37)	17 (28)	6 (10)	48 (80)	4 (7)	8 (13)
Prox. present N = 24	4 (17)	8 (33)	10 (42)	2 (8)	15 (62)	4 (17)	5 (21)

Numbers of samples of children with and without (proximal-) caries and their bacteriological profile with respect to *S. sobrinus* and *S. mutans*. The figures in brackets are percentages of the total number of children with or without disease.

Study 2: The Netherlands

CARIES PREVALENCE

The mean DMFT of the nine-year-old children was 2.9 (S.E. 0.34). Proximal caries was detected in 40 percent of the children and 45 percent of the children had more than three carious lesions or restorations.

BACTERIAL FINDINGS

Of the seventy-two children of this group, 81 percent harbored *S. mutans* in their plaque and 35 percent harbored *S. sobrinus*. *S. sobrinus* in the absence of *S. mutans* was detected in 6 percent of the plaque samples.

The results of the salivary and bacteriological factors are presented as a frequency tabulation in Table 2. The results indicate that the number of plaque samples without detectable *S. mutans* ($< 10^4$) tended to be higher, when caries was not detected, and the number of plaque samples without detectable *S. sobrinus* tended to be higher, when proximal caries was not detected. These tendencies, however, were not significant. Correlations or associations between the different factors were studied using chi-square statistics and regression analysis. High numbers of *S. sobrinus* were compared with high numbers of *S. mutans* using stepwise multiple regression analyses ($p = 0.009$). The buffer capacity and salivary flow rate tended to be higher when proximal caries and caries were absent. This was, however, not significant.

DISCUSSION

The relationship between *S. sobrinus* and dental caries is still unclear. *S. sobrinus* produced acid at pH values below 5.5, while *S. mutans* ceased acid production.[12] Recently, it was shown that *S. sobrinus* is more often found in mouths frequently exposed to acidic solutions.[13] From this we postulated that *S. sobrinus* can be found more often, when the oral environment is acidic by bacterial acid production. This situation is met when much active caries is detected. Masuda *et al* have shown that *S. mutans* favors occlusal fissures, whereas *S. sobrinus* preferentially colonizes smooth surfaces.[14] Children often develop caries of occlusal fissures before proximal caries. It might be possible that individuals with occlusal caries and high numbers of *S. mutans* have an oral environment that is then suited to the establishment of *S. sobrinus*. High prevalence of this bacterium in Icelandic children together with the high prevalence of caries in Iceland suggests a potential relationship between *S. sobrinus* and caries.[2,3]

Difficulties with the identification of *S. sobrinus* on selective media limit the value of conventional cultural methods.[7] This prompted us to use the Mabs produced

S. sobrinus colonies are often identified as *S. mutans*.

Table 2 □ Cross-tabulation of the bacterial findings and salivary factors in relation to the presence of caries or proximal caries from children in The Netherlands.

	S. mutans				S. sobrinus			
CFU/sample plaque	$<10^4$	10^4-10^5	10^5-10^6	$>10^6$	$<10^4$	10^4-10^5	10^5-10^6	$>10^6$
Caries absent N = 40	10 (25)	4 (10)	17 (43)	9 (22)	25 (63)	5 (12)	6 (15)	4 (10)
Caries present N = 32	5 (16)	3 (9)	17 (53)	7 (22)	22 (69)	5 (16)	3 (15)	2 (1)
Prox. absent N = 43	9 (21)	4 (9)	20 (47)	10 (23)	30 (70)	5 (12)	6 (14)	2 (4)
Prox. present N = 29	6 (21)	3 (10)	14 (48)	6 (21)	17 (59)	5 (17)	3 (10)	4 (14)
Salivary factors	flow rate (ml/min)				Buffer capacity (pH)			
	<0.7	0.7-1.1	1.1-2.0	>2.0	<4.0	4.0-5.0	5.0-6.0	>6.0
Caries absent N = 40	9 (23)	11 (27)	13 (32)	7 (18)	1 (3)	9 (22)	10 (25)	20 (50)
Caries present N = 32	8 (25)	11 (34)	11 (34)	2 (6)	0 (0)	3 (9)	16 (50)	13 (41)
Prox. absent N = 43	10 (23)	12 (28)	13 (30)	8 (19)	1 (2)	8 (19)	17 (40)	17 (40)
Prox. present N = 29	7 (24)	10 (34)	11 (38)	1 (3)	0 (0)	4 (14)	9 (31)	16 (55)

Numbers of samples of children with and without (proximal-) caries and their bacteriological profile with respect to *S. sobrinus* and *S. mutans*. The figures in brackets are percentages of the total number of children with or without disease.

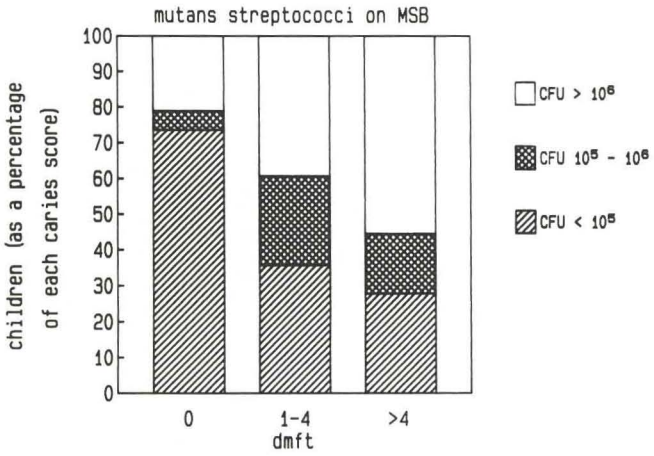

Figure 2. Counts of mutans streptococci *from 10μl tongue loops from five-year-old children of Iceland, cultured on MSB selective media.*

in Amsterdam, in order to perform a more accurate investigation of the role of *S. sobrinus* and *S. mutans* in the carious process.[12] These Mabs have been shown to be a reliable tool to detect and identify the members of the group of mutans streptococci. The immuneblot technique can be used in epidemiological studies, and allow bacteriological analysis to be carried out at a later date, and at a place remote from the investigation and scoring of caries. A useful application to studies of caries in remote communities can be envisaged. Up to now, false positive reactions have not been detected. We do not have any indications of false negative reactions with this technique.

The results of this study show that the proportion of *S. sobrinus*-positive samples from Icelandic children (29 percent) is slightly less than reported previously (34.7 percent) by Holbrook and Beighton in children nine years of age. Another study on Icelandic children ten to twelve years of age showed a prevalence of *S. sobrinus* of 30.2 percent.[4] The present study and that of Köhler and Bjarnason were carried out in Reykjavik, whereas the study of Holbrook and Beighton was conducted largely in towns outside Reykjavik.[3,4] The results of Köhler and Bjarnason are similar to those presented here. The method to detect *S. sobrinus*, as well as the age of the children, differs, however, between both studies. These three groups cannot be directly compared, therefore, and it is not clear whether these results support the finding of Emilson *et al* that the proportion of individuals harboring *S. sobrinus* increases with age.[15]

The high proportion of children with *S. sobrinus* in the Amsterdam study (35 percent) might reflect the caries activity of these children. This was previously found by Huis in 't Veld *et al*, who reported that 40 percent of the caries-active recruits harbored *S. sobrinus*, while only 5 percent of the caries-inactive recruits harbored *S. sobrinus*.[5,16] In the present study in Amsterdam, the IBT was not used. On the basis of previous studies, we think that the number of children with *S. sobrinus* is underestimated. The media used by Huis in 't Veld *et al* were similar, however, to the TYCSB as used in this study and the results, therefore, can be compared.

The results of both studies in Iceland and Amsterdam showed no significant correlation between the presence of *S. sobrinus* and proximal caries. Using MSB media to detect *S. mutans*, a significant correlation was found, however, between the absence of *S. mutans* and a dmft of 0 and there was a correlation between the counts of mutans streptococci on MSB and caries-score in the study performed in Iceland. We do not have any evidence that the MSB counts were related to caries and IBT counts. This might be due to a relation between ability to grow on MSB and cariogenicity, which suggests that the number of colonies on MSB might be used as a diagnostic tool. When studying the prevalence and incidence of mutans streptococci, however, the number of mutans streptococci are underestimated on MSB and the IBT should be used. These suggestions do not explain why a correlation was not found in the study in Amsterdam, in which the selective medium TYCSB was used.

The finding that the absence of caries was related to the absence of mutans streptococci, is in agreement with similar surveys on *S. mutans* in relation to caries.[17,18] A positive bacterial finding is associated with less certainty to caries or proximal caries. A combination of tests involving bacterial and dietary factors seems to offer a better prospect for clinical use, especially in countries such as Iceland with a high caries prevalence unevenly distributed among any given population.[8]

Our results suggest that *S. mutans* and *S. sobrinus* may have different roles in the etiology of dental caries and this should be studied further. The three-year longitudinal study in Iceland is currently being concluded and it is hoped that the results may serve to clarify the role of these organisms in caries.

The authors wish to thank Drs. T.A.J. Snoeks, for allowing us to study her patients, and Ph.J. van Dalen for technical support. Financial support (to WPH) from the Icelandic Research Council, Research Committee of the University of Iceland, and the Swedish Patents Revenue Fund is gratefully acknowledged.

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DETERMINANTS OF EARLY INFANT CRYING AND FUSSING

All infants cry, but they do not all cry the same amount, at the same time, or for the same reasons. Despite the robust nature of the pattern of early crying, all studies describe large individual differences in the amount of crying and fussing. Given the extent to which feeding and crying are assumed to be etiologically related, one might expect feeding choice to be a useful predictor of individual differences in crying behavior. Analogously, given the ease with which a fussy infant can be labeled as being difficult, similar findings might be expected with temperament measures.

The main conclusion of this study is that choice of feeding at birth and temperament are remarkably nonpredictive of early crying/fussing behavior. The perception that infants who are breast-fed initially cry and fuss more appears to be confirmed by small but significant correlations, but these relationships are not stable when considered in the presence of other potential determinants. Infant temperament, at least as shown by the early infant temperament inventory, remains a stable predictor when other background variables are controlled, but accounts for a small proportion of the individual differences. Concurrent feeding at 6 weeks of age is independently related to evening crying and fussing but not to 24-hour duration or frequency. Thus, concurrent feeding is related to the pattern rather than the overall amount of crying and fussing. It is perhaps ironic that neither of the two stable predictors (temperament or socioeconomic status) is easily amenable to modification, whereas choice of feeding, frequently changed in the hope of remedying the problem, has so little explanatory value. The findings nevertheless suggest some relationships with temperament that may contribute to our understanding of infant crying and why formula changes may appear to be useful clinically.

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Use of fluoride supplementation by children living in fluoridated communities

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The efficacy of optimum water fluoridation in the prevention of dental caries is well established, as is the efficacy of fluoride supplementation in areas where optimal water fluoridation is not available.[1,2] Equally well established is the guideline that the prescription of fluoride supplements, in any dose, for children drinking optimally fluoridated water is not proper, because this increases the risk of dental fluorosis.[3-8] Furthermore, previous studies have suggested that many physicians are unaware of the correct protocol for the prescription of supplemental fluorides; that many dentists and physicians do not routinely have the drinking water of their patients tested for fluoride content; and that many physicians inappropriately prescribe fluoride supplements to children living in optimally fluoridated areas.[9-11]

The purpose of this descriptive epidemiological study was to determine the percentage of inappropriate supplementation (i.e. supplementation during residency in an optimally fluoridated area) amongst a cohort of seventh and eighth grade Massachusetts and Connecticut school children, who either displayed mild to moderate dental fluorosis or were fluorosis free.

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METHODS

This study was performed as a part of a larger case-control study designed to investigate risk factors of enamel fluorosis.[12] Seventh and eighth grade Massachusetts and Connecticut school children, representing 1972-1975 birth cohorts, were examined for enamel fluorosis, using the diagnostic criteria of Dean and Moller, by two examiners who demonstrated an inter-examiner and intraexaminer agreement on fluorosis case versus control status, ranging from 88 to 100 percent.

Following these examinations, a self-administered, closed-end questionnaire was sent to the parents of 850 of these children, who either demonstrated mild to moderate enamel fluorosis (fluorosis cases), or were fluorosis free (fluorosis controls) as determined by Dean's index.[13] This questionnaire contained a residence history for the first six years of life as well as questions pertaining to use of fluoride supplements and infant diets. In order to minimize the bias that might result from faulty parental recall, only children who were reported to have lived in a fluoridated community for at least three of the first six years of life were included in this study. For each year, subjects' parents were asked to indicate which one of the following had been prescribed: (1) fluoride drops; (2) fluoride tablets; (3) vitamin drops with fluoride; (4) vitamin tablets with fluoride; (5) plain vitamins without fluoride; or (6) no vitamins used. The use of an inclusive variety of choices, in particular choices (5) and (6) decreased the risk of false positive responses. History of breast feeding was

also ascertained. Only questionnaires completed by parents who had lived with the child during the first six years of life were accepted for analysis. Fluoridation status was determined via the 1975 Fluoridation Census, with fluoridated communities defined as those with greater than 0.7 ppm fluoride in the drinking water.[15] Additionally, median household income, an indicator of socioeconomic status, was obtained for each subject via 1980 U.S. Census tract data.[16] The results are reported summarily for the entire study sample and stratified on the basis of fluorosis status.

RESULTS

A response rate of 80 percent yielded 677 questionnaires. A 10-percent, randomly selected reliability sample (n = 71) returned a second completed questionnaire, at least a month after returning the initial questionnaire; the overall reliability of the questionnaire was 90 percent, based upon this sample. Of the 677 respondents, 10.9 percent (n = 74) indicated that their children had resided in a fluoridated community for at least three years during the first six years of life. Of these seventy-four subjects, 35.1 percent (n = 26) were reported to have been given prescriptions for fluoride supplements, while living in a fluoridated area (Figure 1). Twenty-two different fluoridated communities in ten states were represented in these histories. Seventy-nine percent of these inappropriately prescribed supplements were in the form of vitamin drops or tablets with fluoride, as contrasted to fluoride drops or tablets alone.

Figure 2 gives the percentage of children who were given supplements for at least one year, while living in a fluoridated area, stratified by the fluorosis status of the child. It shows that 40.4 percent of the fifty-two fluorosis cases were inappropriately given supplements, compared with 22.7 percent of the twenty-two nonfluorotic controls.

Figure 3 shows that the percentage of children who were given supplements, while living in fluoridated communities, was similar for the first six years of life within the case group (i.e. ranging from 26 percent in year one to 36 percent in year five). Within the control group, the percentage of children who were given supplements rose from 14 percent to 19 percent between years one and four, then fell to 7 percent in years five and six.

Figure 4 shows that the largest percentage of supplementation during residence in a fluoridated community occurred within the middle ($18,000-$38,000) and high (greater than $38,000) median household income strata for fluorosis cases (i.e. 40 percent each) and within the middle stratum for the control group (i.e. 71 percent). Only 20 percent of the supplemented cases and 10 percent of the supplemented controls were

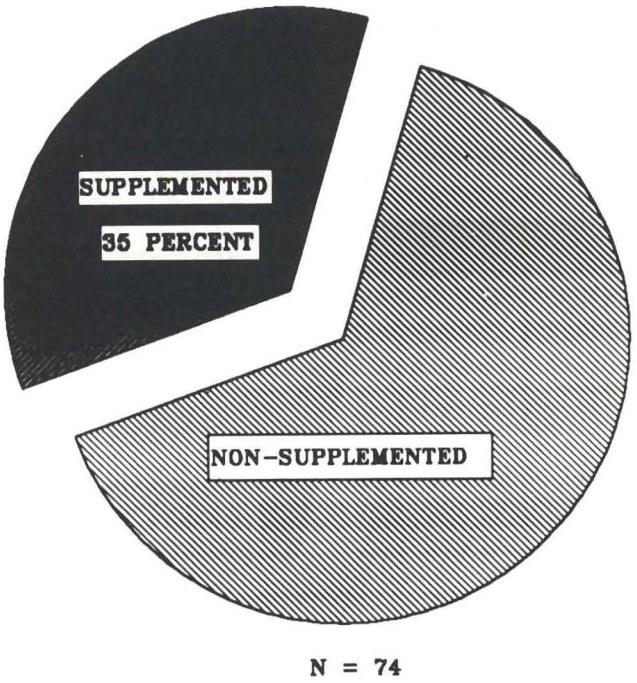

Figure 1. Percentage of subjects who ingested supplemental fluoride while living in a fluoridated area during the first six years of life.

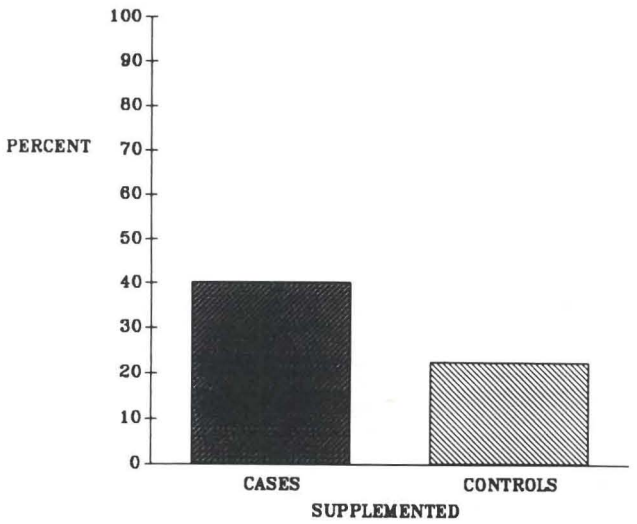

Figure 2. Percentage of fluorosis cases (n = 52) and fluorosis controls (n = 22) who ingested supplemental fluoride while living in a fluoridated area during the first six years of life.

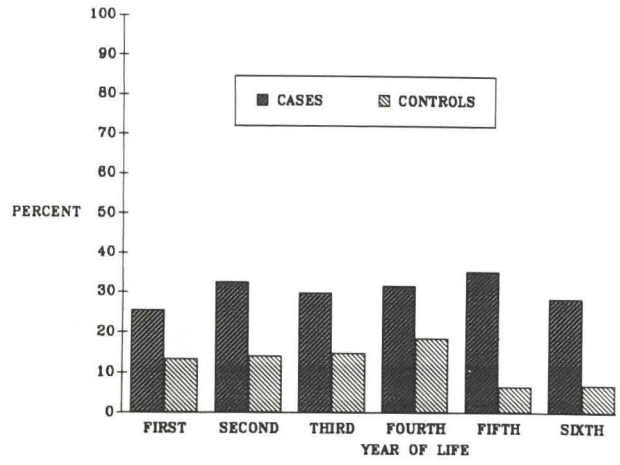

Figure 3. Percentage of fluorosis cases (n = 52) and fluorosis controls (n = 22) who ingested supplemental fluoride while living in a fluoridated area during the first six years of life, stratified by age.

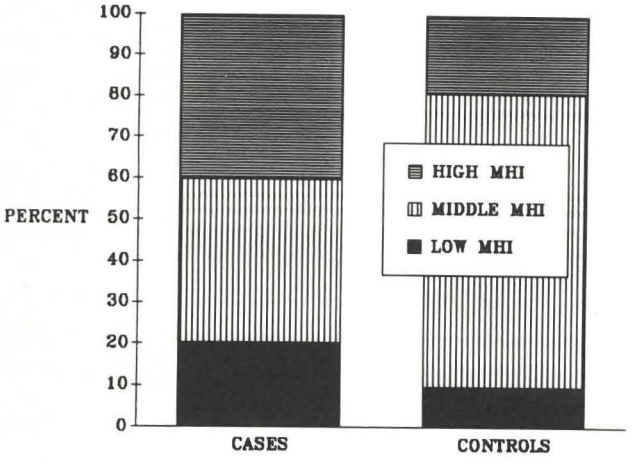

Figure 4. Percentage of fluorosis cases (n = 52) and fluorosis controls (n = 22) who ingested supplemental fluoride while living in a fluoridated area during the first six years of life, stratified by median household income.

drawn from the low (less than $18,000) median household income stratum.

DISCUSSION

The prescription of fluoride supplements was devised as a way to provide the efficacy of water fluoridation in preventing dental caries in areas where water fluoridation was not available and has been shown to be efficacious for the prevention of caries.[2,5,17,18] The prescription of fluoride supplements in fluoridated areas is inappropriate, providing a greater than optimal daily dosage of fluoride.[4,6,18] The findings of this study indicate that fluoride supplements were incorrectly prescribed for a sizeable percentage of children who were living in fluoridated areas during the first six years of life. Further, the finding that the percentage of children given inappropriate amounts of fluoride supplements was nearly twice as high among cases (40 percent) as compared with controls (22 percent) supports the accepted need to adhere carefully to recommended guidelines for the prescription of supplemental fluorides, so as to avoid the increased risk of dental fluorosis. The observation that these children had resided in twenty-two different fluoridated communities in ten different states indicates that the prescription of inappropriate amounts of fluoride was not isolated to a few practitioners and locations, but rather, was geographically widespread. The finding that 79 percent of the inappropriately prescribed fluoride supplement was in the form of vitamin drops or tablets with fluoride suggests that a physician issued the prescription in most cases. The results of this study, which surveyed parents, are consistent with the findings of Margolis *et al*, who surveyed physicians, reporting that 46.3 percent of responding physicians with practices in large fluoridated areas prescribed fluoride supplements.[11]

This descriptive study relied on recall and data records obtained retrospectively. Inherent in a retrospective design is the possibility of faulty recall by parents,

This study indicates that fluoride supplements were incorrectly prescribed for a sizeable percentage of children.

mistakenly reporting the period of appropriate supplementation during periods of residence in nonfluoridated areas to include periods of residence in fluoridated areas. Secondly, appropriately prescribed supplements could have been inappropriately continued by parents following a move from a nonfluoridated to a fluoridated area. These biases are suggested by the finding that the parents of controls who had lived in fluoridated communities for less than three years were three times as likely to report that their child received inappropriate supplements, when compared with controls who had lived in fluoridated communities for three or more years (for cases the difference was only 25 percent). These subjects, who had lived less than three years in fluoridated communities, were considered to represent unreliable outliers and were excluded, therefore, from all of the analyses. The exposure histories for children in this study, all receiving supplements for three or more years, do not appear to be biased from recall or continuation of inappropriate prescriptions, since the rate of inappropriate supplementation was similar for children living three to five years versus all six years in a fluoridated community (i.e. 40 percent versus 38.1 percent for cases in the two subgroups respectively, and 25 percent for controls in both subgroups).

For this study of 7th and 8th graders, the status of household water fluoridation during the first six years of life had to be determined retrospectively; the 1975 Fluoridation Census was used, therefore, as it was in the Margolis *et al* study.[11] It is possible that some residents of census listed fluoridated areas may have been served by low-fluoride well-water, rather than the community fluoridated sources. Given the magnitude of the proportion of cases and controls reported to have inappropriate amounts of supplemental fluoride, however, it is unlikely that this possible source of error would meaningfully change the result. As can be seen in Figure 3, the percentage of children who ingested supplements while residing in fluoridated communities was unacceptably high during all of the first six years of life for the case group (between 25 and 35 percent) and during the first four years of life for the control group (between 12 and 18 percent), suggesting that the high percentage of supplemental use cannot be explained as a reflection of appropriate prescriptions for breastfed children. Specifically, if one assumes that all subjects who were breast-fed and who also ingested supplemental fluoride during the first year of life ingested it only while breast-feeding occurred (i.e. were appropriately supplemented), the overall percentage of inappropriate supplementation does not change, since a high percentage of these same children ingested supplements after age one.

As shown in Figure 4, the largest proportion of children who ingested supplemental fluoride was from the middle and high median household income strata. Similarly, the majority of the controls who ingested supplements was from the middle median household income stratum exclusively. This finding indicates that the observed high prevalence of inappropriate use of supplements was not derived from either a high or low outlying socioeconomic group.

The children in this study were from 1972-1975 birth cohorts, and these findings are for events that occurred during the mid to late 1970s. Nevertheless, while it might have been hoped that prescribing practices would improve for post-1975 birth cohorts, the literature suggests that this has not occurred. Pinkerton *et al* reported that residents in family-medicine failed to improve their prescription habits even after receiving specific instruction; improvement occurred only after a period of individual monitoring and feed-back.[19] Levy *et al* reported that in North Carolina only 8 percent of dentists and 3 percent of physicians likely to have children as patients were submitting water samples to laboratories for analysis of fluoride concentration.[10] Gift *et al* reported that in a national survey of physicians, 5 percent indicated that their child patients received fluoride from supplements as well as a community water system.[20] Over 90 percent of the physicians indicated that they used the amount of fluoride in the drinking water as a criterion for prescribing supplements; the percentage of physicians who actually sampled patient drinking water for fluoride content, however, was not reported. Siegel and Gutgesell reported that in Harris County, Texas only 50 percent of surveyed physicians knew the fluoride content of the drinking water in their practice area and only 45 percent knew the correct dosage schedule.[9] In a follow-up to their first study, Margolis and co-workers reported that the percentage of pediatricians and physicians prescribing fluoride supplements for bottle-fed children living in fluoridated areas had remained about the same.[11,21]

In recent years, an increased prevalence of enamel fluorosis in optimally fluoridated communities was reported.[22,23] The findings of this study suggest an explanation for this increase and further support the recommendation by others for enhanced professional education and monitoring to ensure that appropriate prescription practices occur.[24,25]

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PLAQUE FLUORIDE

The sources of plaque fluoride include the enamel during surface demineralization, the diet, products for dental health, and the oral fluids, principally the saliva and gingival crevicular fluid. The relative contributions of these different sources to the fluoride pools of plaque have not been defined. The regular use of fluoride dentifrices or rinses probably elevates plaque fluoride levels throughout some portion of the day more than is possible from drinking water, the diet or the oral fluids. This may not be the case, however, because of the differences in exposure time. The typical exposure to the high concentrations of dental products is brief and may occur only once each day or less. It is known that, after their use, the fluoride concentrations of whole saliva decline rapidly to reach or closely approximate control levels during the following hour [Weatherell *et al*, 1986]. The daily exposure time of teeth to the liquids and foods of the diet is greater, the exposure to the oral fluids, although reduced during sleep, is virtually continuous.

Whether the higher fluoride levels of the oral fluids and dental plaque that may occur, however briefly, after the use of fluoride products are of much clinical significance is not clear, particularly for persons whose drinking water fluoride level is about 1 ppm. One reason for this is that, prior to the availability of fluoride-containing products and compared to areas with low water fluoride levels, the prevalence of dental caries was reduced to 40 to 60 percent in areas with water fluoride levels of about 1 ppm. This points to the possible existence of a plateau effect in the relationship between plaque and oral fluid fluoride concentrations and cariostasis. A considerable amount of additional work is needed in this important research area which bears directly on the rational use of fluoride for the control of dental caries.

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Pits and fissures: remnant organic debris after acid-etching

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Fissure sealants are now regarded as a definitive mode of treatment in the prevention of fissure caries. The view that sealants are not as effective as they could be still remains, however, within the profession. This is due in part to early studies showing high failure rates of resin fissure sealants. Failure of sealants can be attributed to inproper handling of materials and the introduction of contaminants such as lubricating oil from handpieces, organic debris, salivary pellicle, reaction by-products after phosphoric acid application, and organic vehicles in prophylaxis pastes. These factors will reduce the bond strength of the resin to the etched enamel surface.

The two most important factors in obtaining a clean enamel surface receptive to the sealant material are the removal of surface debris and pellicle, and the quality of the etched surface.[1,2] It was previously reported that pumicing removes organic material on smooth enamel surfaces. This view does not, however, apply to teeth with fissures.[3,4]

Several groups conclude that pellicle is removed during etching.[5-8] Thus, in the region of fissures, etching should remove the remaining pellicle and debris, allowing a clean surface receptive to the fissure-sealant material. The aim of this study is to:

- ☐ Determine whether etches remove further debris after prophylaxis.
- ☐ Examine and compare the efficacies of a liquid and a gel etchant.

Much work has been done to determine the effect on enamel of different etching materials, times, and concentrations. Etching solutions such as phosphoric acid and citric acid have been tested to find the optimal concentration for enamel dissolution.[9,10] The most effective acid was shown to be phosphoric acid using concentrations varying between 30-50 percent.[11-17] More recently it was shown that a 40 percent solution produces the greatest dissolution of calcium from the enamel surface.[17]

The effect of viscosity on the efficacy of etchant materials has been inconclusive, with some studies showing liquid etch to be better than gel; whereas others indicated no difference.[1,15,18]

Etching times of between five to 120 seconds have been studied, and shown to give adequate resin bond strengths.[2,16,19-21] The manufacturers' recommendation is usually sixty seconds, which has been used in a number of previous studies.[5,8,22,23]

MATERIALS AND METHODS

Teeth used for this study were stored for varying periods and in a variety of solutions: formal saline, absolute alcohol, water, Ringers solution and 0.5 percent Chlorhexidene in 0.5 percent aqueous Cetrimide.

Two mechanical cleaning methods were used:

- ☐ Pumice and water slurry on a bristle brush in a slow speed contra-angle handpiece for 30-45 seconds.

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☐ Sodium bicarbonate in an air/water slurry (Airflow†) for 30-45 seconds.

Teeth were etched with either liquid* or gel** phosphoric acid. The controls were either (a) the whole occlusal surfaces cleaned and not etched or (b) half of one occlusal surface used as a control for the other half (Figure 1). Observations were made for 237 fissure sites, divided into eight groups for comparison.

Etchant was placed for sixty seconds, washed off in running tap water for at least thirty seconds, and then dried with compressed air. Some of the teeth had the liquid etch agitated with an explorer over half the occlusal fissures while on the control half the etchant was left undisturbed. The stain used for testing for pellicle remnants was Analine Blue - Orange G[4] and was examined under low-power magnification.

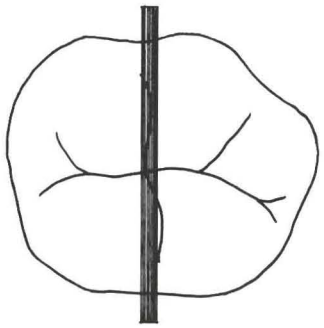

Figure 1. Illustration showing a tooth divided in half using a fine strip of wax so that treatment or nontreatment of one half could be compared with the other.

Method of debris/pellicle recording and analysis

The teeth were scored for the presence of debris/pellicle in the fissures by using a linear scale of 1 to 7; 1 being the least amount of debris, and 7 being the greatest. The score was determined by observation against a set of four standardized photographs as used in the previous study; when in doubt the lower (or better) score was recorded (Table 1).[4] The results were then analyzed statistically (Pearson Chi-square analysis) (Table 2).

RESULTS AND DISCUSSION

The effect of acid-etch solutions on the removal of further debris, after cleaning the teeth was insignificant in all cases analyzed, except for three:

☐ Airflow: Airflow with liquid etch.

☐ Pumice/water with liquid etch: Airflow with liquid etch.

☐ Pumice/water with gel etch: Airflow with gel etch.

The reason for the latter two producing significant differences can be explained by a previous study, in which it was shown that the Airflow technique is more effective for removal of pellicle/debris than pumice and water.[4] The significant result produced for Airflow: Airflow with liquid-etch comparison, however, is unclear. Such factors as variation between teeth, quality of the pellicle/debris (i.e. thickness, adherence, and depth of penetration into the enamel) may have caused variation of the results.[24,25] It may also be a random variation produced in this grouping.

†Airflow, Electro Medical Systems SA, Switzerland.

*Liquid etch—40 percent orthophosphoric acid, SS White, New Jersey, USA.

**Gel etch—Getz, Gel Etchant. Teledyne Getz, Elk Grove Village, Illinois, USA.

Table 1 ☐ Percentage figures comparing different test methods as scaled into groups against a photographic standard.

Test method	Scale grouping 1	2	3	4	5	6	7
Pumice/water	2.5	23	33.3	28.2	10.2	2.5	0
Airflow	60.6	24.2	15.1	0	0	0	0
Pumice/water with liquid etch	6	12	60.6	15.1	6	0	0
Pumice/water with gel etch	0	25	20	20	10	0	
Airflow with liquid etch	16.2	51.3	29.7	2.7	0	0	0
Airflow with gel etch	17.3	47.8	30.4	0	4.3	0	0
Pumice/water with liquid etch agitated	3.7	29.6	51.8	14.8	0	0	0
Airflow with liquid etch agitated	32	48	20	0	0	0	0

Figure 2. Specimen showing remaining debris (yellow) after cleaning and etching the tooth.

Figure 3. Specimen shows partial etching of enamel below an attachment line of the pellicle, which shrunk away in SEM preparation.

Accumulations of debris and pellicle remained even after cleaning and etching.

Several specimens from different groupings had very thick accumulations of surface debris and "old" pellicle, which remained even after cleaning and etching. The deposits that remained were observed on the inclined walls of the fissure (Figures 2,3), away from the cuspal tips. This observation indicates how tenaciously the pellicle/debris can adhere to the tooth surface; this seems to occur more frequently in "old pellicle" and in sulcate grooves. A possible cause could be pellicle fixation, while in storage solutions. The mechanical removal of surface debris and "young" pellicle from newly erupted teeth may not be necessary, as this pellicle is thin and may float off after acid-treatment. Similarly, saliva contamination immediately after etching needs reetching for removal.[26] Although Silverstone *et al* showed pellicle removed by using an acid etchant solution only, as determined by SEM studies, the sample used in this study with dye marking suggests the routine use of mechanical cleansing before etching is necessary.[26]

The region where the use of acid for removal of debris would be of most benefit is at the base of fissures.

Table 2 ☐ Statistical comparison between test groupings.

Pumice/water	Pumice/water with liquid etch	$p>0.05$
Pumice/water	Pumice/water with gel etch	$p>0.05$
Airflow	Airflow with liquid etch	$p<0.05$*
Airflow	Airflow with gel etch	$p>0.05$
Pumice/water with liquid etch	Airflow with liquid etch	$p<0.05$*
Pumice/water with gel etch	Airflow with gel etch	$p<0.05$*
Pumice/water with liquid etch	Pumice/water with gel etch	$p>0.05$
Airflow with liquid etch	Airflow with gel etch	$p>0.05$
Pumice/water with liquid etch	Pumice/water with liquid etch agitated	$p>0.05$
Airflow with liquid etch	Airflow with liquid etch agitated	$p>0.05$

*significant difference

It has been shown, however, that some debris was retained in this area even after etching. It appears that the acid-etchant, either liquid or gel, may not in fact reach the base of fissures because of such factors as air entrapment, and wettability of the etching-agent. When a sharp dental explorer was used during etching to ensure that no air became entrapped, the result was found to be no different. Debris was still present, and the base of the fissure still appeared to remain unetched. A recent study, using the SEM, has indicated almost identical results.[18]

This recent study and the present study have both shown that there is little or no difference in the efficacy of either a gel or liquid etchant for enamel preparation before the placement of a resin sealant, for the samples tested. Remaining debris and pellicle are not removed in the fissure bases by the etching process and the use of a dental explorer has little or no effect. In this work, pellicle and debris were better differentiated with stains and optical microscopy than with SEM examination.

Further work should be considered to obtain a technique that enables etching to the base of the fissure and removal of the remaining pellicle and debris, as this may enhance the retention of fissure sealants.

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In vitro fluoride uptake by enamel adjacent to a glass ionomer luting cement

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Enamel decalcification and caries associated with orthodontic banding and space maintenance concern the dental profession.[1-4] Orthodontic bands decrease the effectiveness of oral hygiene measures, often resulting in decalcification of the enamel adjacent to the margin of the band. If oral hygiene measures are inadequate, this decalcification can lead to caries. Moreover, should the luting agents dissolve in oral fluids, underlying tooth structure becomes exposed to the oral environment. This underlying tooth structure may be inaccessible to normal oral hygiene methods and can promote the caries process. This can be especially destructive with bilateral space maintainers and orthodontic appliances, should one band lose all of its cement and the other band remains attached.

The reduced incidence of caries along margins of silicate restorations has been documented.[5,6] These restorations leach fluoride constantly.[6] The cariostatic effect of continuous low levels of fluoride has been reported by several authors, and suggests that the fluoride prevents caries by two mechanisms.[6,7] First, it acts to decrease enamel solubility. Second, it may alter the metabolic activity of plaque. The effect of fluoride on teeth is not a static one; it is a constantly changing, dynamic process. Koulourides reports surface fluoride is lost with time.[8] Stookey found a continuous numerical decrease in enamel fluoride content over twenty-one days, after the application of topical fluoride to incipient lesions.[9] It is because of this dynamic process that continuous, low levels of fluoride in surrounding fluids becomes important.

When used as a restorative material, glass ionomer cements release fluoride at a constant, low level.[10-12] One report shows it to be superior to silicates in this respect.[13] The benefit of fluoride adsorption is seen not only in enamel immediately adjacent to the glass ionomer restoration, but has also been reported in areas up to three millimeters away from the restoration's margin and may offer protection to the entire tooth.[5,6,14] The effect of glass ionomer on the enamel of teeth adjacent to the tooth having the glass ionomer restoration, however, has not been examined. In addition, the fluoride release by glass ionomer when used as a luting agent has not been investigated. As contrasted to glass ionomer restorations, when used as a luting agent, only a small margin of cement is exposed to the oral environment; less fluoride may be available, therefore, to go into solution.

In addition to the benefit of fluoride release, glass ionomer cements are extremely biocompatible, have low solubility, and, if handled properly, adhere to enamel, dentin, and some metals.[15-23]

The purpose of this investigation is to determine the

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amount of fluoride adsorption by human enamel in teeth adjacent to those that have been banded using a glass ionomer luting agent. If enamel fluoride uptake is found, this would be of significance in orthodontics, fixed prosthetics, and space maintenance therapies.

MATERIALS AND METHODS

Forty-five extracted, noncarious, human molars were stored in distilled water and refrigerated until use. These teeth were not selected with consideration to history of fluoride exposure. Fifteen sets of teeth were prepared by mounting the apical halves of the roots of three molars in acrylic resin. The middle tooth of each set had previously been fitted with an orthodontic band, then mounted between two adjacent molars. The teeth were numbered for identification. At this time the band was removed from the middle tooth and a base line microbiopsy procedure was accomplished on the adjacent teeth of each set.

The selected baseline locations were immediately proximal to the band's cement margin (Figure 1). Specifically these locations were:

- ☐ The occlusal limit of the mesiolingual line-angle of the distal molar (Site A).
- ☐ the gingival limit of the distofacial line-angle of the mesial molar (Site B).

The technique used is similar to that used by Vogel *et al* and Retief *et al.*[5,23-26] A one-millimeter-diameter hole was punched in a strip of adhesive tape (#DLA 12085C5482, Propper MFG. Co., Inc., Canada) with a rubber dam punch (Ivory Co., Inc., 660 Jessie St., San Fernando, CA 91340). This tape was then placed over the intended biopsy area and margins of the perforation were burnished to give a positive seal, thereby confining the etching solution to the designated area. A 10 μm Hamilton syringe (#701N, Hamilton Co., Reno, NV 89501) was used to dispense 10 μl of 0.5M $HC10_4$ (perchloric acid) on the enamel site. It was allowed to interact for fifteen seconds, then was withdrawn in the same syringe and transferred to a 5 ml polypropylene test tube (#2053, Becton, Dickenson & Co., Oxnard, CA 93030). The etched area was washed with 40 μl of distilled water from a 250 μl Hamilton syringe (#705N, Hamilton Co., Reno, NV 89501). The washing was added to the test tube. The tubes were numbered, covered with a parafilm test tube cover (Marathon Products, Neenah, WI), and placed in a centrifuge for 5 min. The solution was then divided in half; 25 μl for calcium (Ca) analysis and 25 μl for fluoride (F) analysis. The 25 μl of solution for F analysis was diluted with 160 μl of Total Ionic Strength Adjustment Buffer (TISAB, Fisher Scientific, Pittsburgh, PA). This is a commercial buffer that makes the etching solution alkaline to prevent loss of fluoride during storage. Fluoride analysis was done using a Combination Fluoride Electrode (#960900, Orion Research Inc., Boston, MA 02129) coupled to an Orion digital pH meter (#611, Orion Research Inc., Boston, MA 02129).[27-29] A calibration curve using standard F solutions was constructed and used to determine parts per million of F in the test solutions.

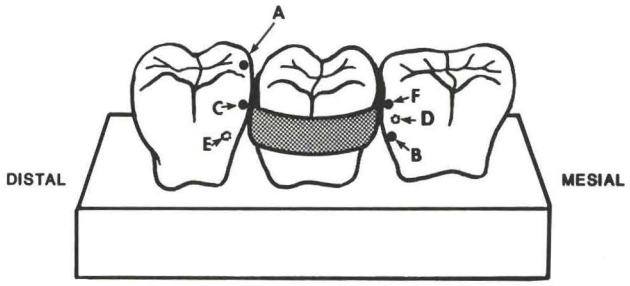

Figure 1. Biopsy sites as described: dotted sites represent gingival lingual surfaces.

Calcium content of the samples was determined by calorimetric analysis (Gilford system 103, Gilford Systems, Oberlin, OH 44070) to assure a consistent depth of etch of each tooth for comparison. The two chemical analyses were performed by personnel at the Clinical Investigation Facility, Wilford Hall Medical Center, Lackland AFB, TX.

After the baseline analysis was complete, the adapted orthodontic band was cemented to the center tooth of each set with a glass ionomer luting cement (Ketac-Cem ESPE, Premier, Norristown, PA). Mixing was done as described by McLean *et al.*[9] Excess cement was trimmed after five minutes. A varnish for protection of margins is unnecessary with this water-hardened glass ionomer.[9] Six minutes after the start of mix, each set was inverted and suspended in distilled water so that the acrylic resin did not contact the solution, but the band margins were immersed. The teeth were stored in water at 37°C (Versabath, Fisher Scientific, Pittsburgh, PA), which was changed every two weeks.

At the end of thirty days the teeth were washed with distilled water and biopsies were obtained at the second site on the mesial and distal molars (Figure 1). These were:

- ☐ The occlusal limit of the mesiofacial line-angle of the distal molar (Site C).
- ☐ The gingival limit of the distolingual line-angle of the mesial molar (Site D).

At the end of sixty days, the procedure was repeated (Figure 1) at:

- ☐ The gingival limit of the mesiolingual line-angle of the distal molar (Site E).

☐ The occlusal limit of the distofacial line-angle of the mesial molar (Site F).

The analysis of each of these samples was conducted as described above. After the two-month analysis, the banded tooth was removed from each setup and cement margin widths closest to the biopsy sites of adjacent teeth were measured (Unitron 11377 microscope, Japan).

RESULTS

Fluoride levels of the solutions were compared by tooth and by biopsy location. The baseline fluoride mean was compared with the one-month fluoride mean by paired *t*-tests (Table). The means of occlusal and gingival sites were figured separately. The gingival sites had an increased fluoride level over the one-month period, which was statistically significant ($P < 0.05$). The occlusal sites had a numerical increase, but it was not statistically significant. The baseline was compared with the two-month mean by an unpaired *t*-test, using Welch's approximation, used because the two-month biopsy sites differed anatomically from baseline sites (i.e. occlusal vs. gingival). The numerical mean at two months increased from baseline, but decreased from the one-month level.

The two histograms (Figure 2) show a separation of teeth into three categories of fluoride concentration. Although not statistically significant, these graphs indicate a general trend of increasing percentages of higher fluoride concentration with time.

A comparison of gingival versus occlusal sites, using the unpaired *t*-test with Welch's approximation, revealed similar baselines and a significant difference at one month. At two months there was no statistical significance between the gingival and the occlusal sites (Table).

An analysis of variance of individual teeth demonstrated that teeth with higher baseline levels of fluoride had smaller increases than those with lower baselines. This was statistically significant ($P < 0.05$).

Paired *t*-tests indicated that variability of cement width was not statistically significant when compared with amount of fluoride adsorbed at any location ($P > 0.05$) The mean cement width was 0.564 millimeter with a standard deviation of 0.294 millimeter.

Table ☐ Fluoride concentration in solution (PPM)

	Baseline	One Month	Two Months
Occlusal mean (*)	0.478 (0.065)	0.552 (0.160)	0.544 (0.205)
Gingival mean (*)	0.455 (0.068)	0.794** (0.366)	0.594 (0.211)

*Standard deviation
**Statistically significant to a 0.05 level

Used as a restorative material, glass ionomer cements release fluoride at a constant level.

DISCUSSION

Many investigators have shown the ability of glass ionomer cement restorations to increase fluoride content of enamel adjacent to a restoration.[5,6] This study demonstrates that one glass ionomer luting agent, with a relatively small, exposed surface-area, influences the fluoride concentration of teeth adjacent to the banded tooth.

Two factors to be considered in the amount of fluoride that the enamel adsorbs are the amount of fluoride available and the ability of the enamel to accept additional fluoride. The fluoride available for uptake is influenced by many materials daily (i.e. dentifrice, rinses, gels, water, restorative material). The benefit from these can be additive. Variations in the width of the exposed cement would be expected to alter availability of fluoride; but within the confines of this study, no difference in uptake was seen.

The ability of enamel to accept additional fluoride varies from patient to patient, tooth to tooth, and even different sites on a single tooth. It is a dynamic process with action in both directions. One of the variables examined in this study was baseline fluoride. Teeth with lower baseline levels of fluoride had larger increases in fluoride levels at one-month and two-month intervals. Since the amount of fluoride available was comparable for all teeth, we must conclude that the

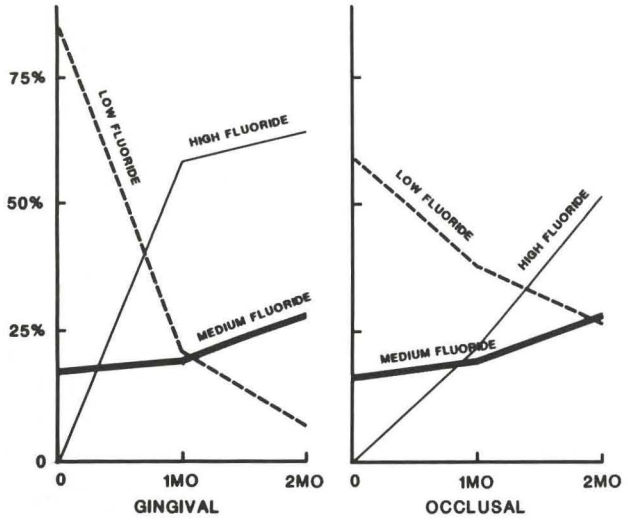

Figure 2. Percent of sites categorized (PPM) as low fluoride (0.00-0.49), medium fluoride (0.47-0.81), and high fluoride (0.81-1.40).

teeth with higher baseline levels were less capable of accepting more. Clinically this means that the patients who need the fluoride most, will receive the greatest benefit from the glass ionomer cements.

The dynamic character of enamel was evident in this study. The fluoride levels increased in the first month, then leveled off or decreased slightly in the second month. This is partially caused by decreased fluoride released from the glass ionomer cements with time. In addition to this, these teeth were in distilled water, which favored outward diffusion.

A timed release of fluoride from glass ionomer cements used for orthodontic banding or space maintenance is especially desirable for children with less than ideal oral hygiene. Special handling is required, however, to optimize the physical properties of glass ionomer cements. Since these cements must remain uncontaminated from moisture for at least four minutes to prevent increased solubility and washout, isolation is required. The adhesive properties of glass ionomer cements coupled with the fluoride release observed from these cements make them an ideal choice for band cementation.

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Speech articulation

Tongue skills and clearance of toffee in two age-groups and in children with problems of speech articulation

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During the chewing and swallowing of sticky food such as toffee and the subsequent scavenging of particles lodged between the teeth and in areas such as the buccal sulcus, the tongue executes highly coordinated, precise movements. These are made possible by the highly developed feedback from tactile, pressure, and stretch receptors in the tongue. The importance of oral sensation and tongue motor skills in articulation has been, however, the subject of much argument.[1-3]

In a recent pilot study, poorer overall tongue skills were observed in seven children with impaired articulation than in ten controls, but only three of the seven showed delayed rates of toffee clearance.[4]

The present study extends that preliminary investigation by examining a much larger sample over a smaller age-range and with more defined speech pathology and also examines the influence of an age-gap of some thirteen years on tongue skills and toffee clearance rates in young children and students without any speech defects.

SUBJECT SELECTION

Consent was obtained from parents, headteachers or student volunteers and approval was obtained from The

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Table 1 □ Selection of subjects for Study A (age) and Study B (speech)

		Numbers and gender		Age (yr)		Selection criteria
				Median	Range	
A.	Group 1	15M	14F	8	6-11	No physical or mental abnormality, orthodontic appliance, or denture.
	Group 2	12M	11F	21	19-23	
B.	Group 1	33M	7F	7	5-8	As above
	Group 2	32M	7F	7	5-8	Diagnosed as having impaired speech, but no hearing deficiency or learning difficulty.

None of the children in Study A participated in Study B.

student volunteers and approval was obtained from The London Hospital Ethics Committee. The criteria for selection of subjects are outlined in Table 1. The unequal distribution of boys and girls in the control group in Study B was dictated by the need to match the predominance of boys in the speech-impaired group.

EXPERIMENTAL METHODS

The sensory awareness of the tongue was assessed by determining oral stereognosis: the faculty of identifying the shape of objects in the mouth. The ability to recognize on a chart ten from a possible fourteen randomly presented small plastic shapes (largest dimension 10 mm) moved around between the tongue and the palate, was measured. As each shape was attached by a thread held by the operator, there was no risk of it being swallowed. The total number of errors (0-10) and the sum of the magnitude of each error (0-2) were recorded. An error in identifying closely similar shapes such as a circle, polo-mint or egg shape was scored as 0.5, whereas confusion between square, star and triangle was 1.0, circle and square 2.0.

Sense of tongue position and fine muscular control were tested in two ways. Firstly, tongue tip manipulation skill. The subject attempted to rotate as rapidly as possible with the tip of the tongue a small fin mounted on a spindle within a perspex block (Figure 1) that was held between the upper and lower incisors. After one practice, the number of rotations in two timed periods, each of 30s, was recorded on a digital counter.

The precision with which the protruded tongue could maintain a small force was also measured. Although there were minor differences in the techniques used in the two studies, the principle was the same. The subject exerted a force by protruding the tongue against a rubber tambour and attempted to keep this force close to a desired force of 45g indicated on a scale (Figure 2). After one practice, records were obtained over three short periods, each of 5-10s and the cumulative error was expressed in arbitrary units in unit time. The greater the value, the poorer the control of tongue protrusion. All equipment in contact with the mouths of subjects was sterilized after use.

The toffee clearance rate was measured by following the fall in sugar levels in the mouth after toffee had been chewed and swallowed. Each subject was given 8g toffee and asked to chew and swallow this in a normal way and to indicate when this was completed. At regular intervals for about 10 min after the completion was signalled, a small 1 cm^2 filter paper was drawn across the center of the front of the tongue with blunt forceps. The paper, which rapidly became saturated

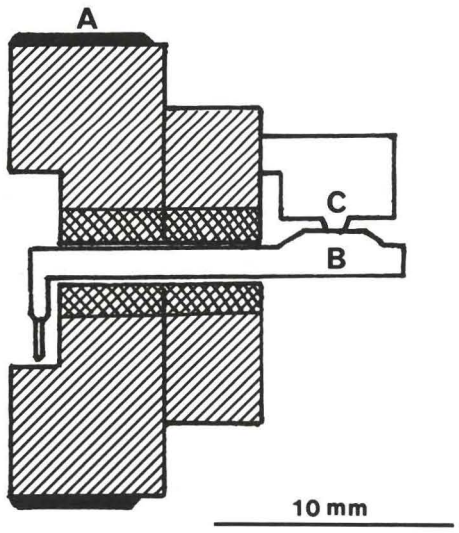
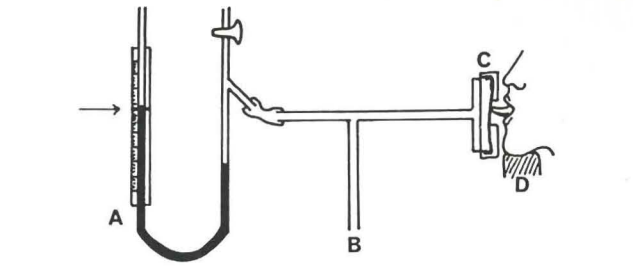
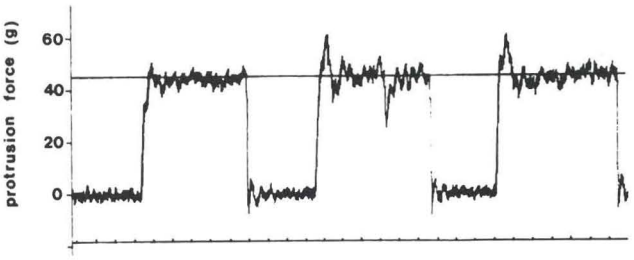


Figure 1. Equipment used in measuring tongue tip manipulation. The perspex block measuring 30 x 20 x 10 mm had a rubber sleeve (A) around it for the subject to bite upon. As the spindle (B) rotated through 360° it activated a micro switch (C) which was connected to a digital counter.





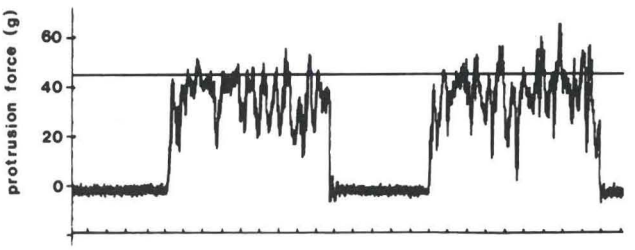


Figure 2. Diagram of apparatus used to measure the control of tongue protrusion: A, Water manometer with desired range equivalent to a protrusion force of 45 g marked on scale (→); B, Connection to a pressure-transducer (UP1, 500 ohms resistance. Ether Ltd. Stevenage, U.K.), amplifier and either pen recorder or voltmeter. In Study A, a voltmeter replaced the water manometer and the voltage output was converted to a frequency modulated tone and stored on standard audio-cassette tape; C, Rubber tambour and perspex guard; D, Adjustable chin-rest. Examples of records obtained from two subjects showing good control in the upper records and poor control in the lower records. The horizontal calibration line represented a 45g protrusion force. A 1-second time trace is shown.

with saliva, was withdrawn, blotted free of excess saliva and the absorbed saliva was extracted and analyzed for sucrose. The mean volume of saliva collected on the paper by this method in ten tests was 1.38 ± 0.96 µl (S.D.). Graphs showing the sugar concentration against time were plotted for each subject.

DATA ANALYSIS

The two-tailed Mann-Whitney nonparametric U test was used to determine the significance of differences between two populations in which the values were not normally distributed and the sample variances were very different. Medians and ranges were quoted for each population.

Correlations within each group between pairs of tongue skills and between any one of these skills and a clearance value were determined using the Spearman rank correlation method.

RESULTS

Study A

Despite the large range of results for tongue skills within each group, there was a statistically highly significant difference between the age-groups for each of the tongue skills (Table 2). A marked improvement was seen in the older group. Such a change was not obvious over the five-year age-span in the younger group, but the age distribution of the children was very skewed. No gender differences were observed in either group.

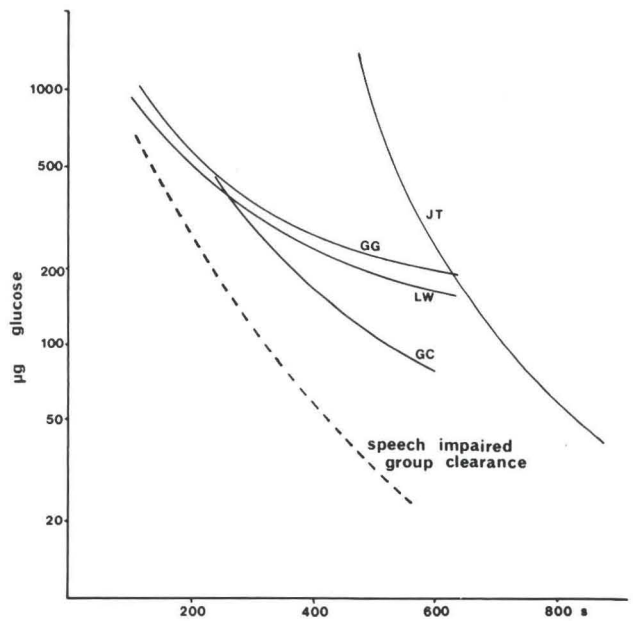


Figure 3. Toffee clearance curves for four speech-impaired children compared with the representative curve for the thirty-nine speech-impaired children.

In contrast to the findings on tongue skills, there was no significant difference in the chewing-swallowing times between the two age-groups (Table 3) and only a questionable small difference in the clearance rates (Table 3). At only two stages after chewing the toffee, did children have significantly higher levels of sugar in their mouths than students.

Table 2 ☐ Tongue skills in children (group 1) and young adults (group 2).

	Group 1		Group 2	
	Median	Range	Median	Range
Oral stereognosis:				
Total number of errors	4.0	0-7.0	1.0	0-5.0*
Sum of magnitude of errors	3.0	0-7.0	0.5	0-4.0*
Tongue tip manipulation	5.0	0-15.0	12.5	1-26.0*
Tongue protrusion control error	15.5	6.6-43.0	11.5	5.9-19.5*

*All the differences were statistically highly significant as evaluated by the Mann Whitney test; $P < 0.001$.

Table 3 ☐ Toffee clearance data in children (group 1) and young adults (group 2).

	Group 1 (29)		Group 2 (23)	
	Median	Range	Median	Range
Chewing-swallowing time (s)	53	39-125	50	38-92
Glucose content+ at timed intervals				
75s	620	(185-1900)	470	(185-900)
150s	340	(140-1050)	245	(105-510)
300s	100	(30-370)	70	(25-220)*
450s	40	(5-165)	20	(0-100)*
600s	15	(0-50)	5	(0-50)

+Sucrose in saliva sample was determined as μg glucose
*Differences between groups were statistically significant as evaluated by the Mann-Whitney test; $P > 0.01 < 0.05$.

Table 4 ☐ Tongue skills in normal children (group 1) and speech-impaired children (group 2).

	Group 1 (40)		Group 2 (39)	
	Median	Range	Median	Range
Oral stereognosis:				
Total number of errors	4.0	0-8.0	6.0	1.0-10.0*
Sum of magnitude of errors	3.5	0-10.5	5.5	1.0-13.0*
Tongue tip manipulation	6.0	0-27.0	5.0	0-14.0
Tongue protrusion control error†	2.5	0.2-6.1	3.9	0.2-8.7*

†in arbitrary units which are different from those used in Study A (Table 2).
*Differences between the groups were statistically significant as evaluated by the Mann-Whitney test; $P < 0.01$.

Table 5 ☐ Toffee clearance data in normal children (group 1) and speech-impaired children (group 2).

	Group 1 (40)		Group 2 (39)	
	Median	Range	Median	Range
Chewing-swallowing time (sec)	50	30-245	90	35-485*
Glucose content (μg) at timed intervals				
120s	205	20-2300	640	120-3500*
240s	65	0-700	190	38-800*
360s	28	0-330	78	11-300*
Time (s) to reach glucose contents of				
500 μg	60	12-282	132	12-540*
100 μg	186	60-684	318	150-1020*

*All the differences between the groups were statistically significant as evaluated by the Mann-Whitney test; $P < 0.01$.

When the subjects within each group were ranked according to their scores in each of the tongue skills and for their toffee clearance data it was found that the only significant correlation was between oral stereognosis and tongue-tip manipulation in Group 1 ($R = 0.54$; $P = 0.01$). Those with a well-developed stereognostic ability were better able to manipulate their tongues rapidly. There was no statistically significant correlation between any of the other tongue-skill scores or between these and clearance data.

Study B

Children with impaired articulation performed less well than controls in the three tests of tongue skill, but only the differences for oral stereognosis and tongue protrusion control were statistically significant (Table 4). No correlations were observed between rankings of tongue skills in either group of children. Unlike Study A, there was no correlation between oral stereognosis and tongue-tip manipulation.

The overall poorer tongue skills of the speech-impaired group (Table 4) were associated with an overall poorer rate of toffee clearance (Table 5). The time taken to chew and swallow the toffee was significantly longer than in the control group and the subsequent clearance of sugar from the mouth was significantly slower. Associations between tongue-skill measurements and toffee-clearance values are implied from the group data in Tables 4 and 5; but when children in each group were ranked according to their tongue-skill scores and clearance figures there were no significant correlations. Even so, it was of interest to attempt to relate the tongue-skill scores to the speech pathology in the four children displaying the most deviant clearance curves. These results (Figure 3 and Table 6) are discussed later.

DISCUSSION

Our finding that the sensory acuity of the tongue, as tested by oral stereognosis, improved with age, confirms previous reports.[1,5,6] Our results also suggest, however, that this improvement extended to the integration between sensory feedback and muscle control, since we observed markedly better tongue-tip manipulation and protrusion control in the older group. We do not think intelligence plays a part in this; all the children could readily follow the instructions. Better motivation in the student group cannot be ruled out as a contributory factor.

Interpretation of clearance data is always compounded by considerations of salivary flow. As both chewing times and clearance were delayed in the children with problems in articulation, it is suggested that 'handling' difficulties rather than restricted salivary flow were responsible. The trend toward slower clearance in the younger group in Study A, however, might be partly explained by differences in salivary flow, since it has been reported that flow-rate increases with age up to about fifteen years.[7,8]

It was not unexpected to find that the scores for the particular tongue skills that were tested showed little correlation with each other within a group, since these skills probably depend on different sensory and motor activities. Although as a group, the speech-impaired children with poorer tongue-skills had delayed clearance and took significantly longer to chew and swallow the toffee than the control group, there was little cor-

In some speech-impaired children, there seemed to be some relationship between toffee clearance and tongue skills.

relation between these measurements within the group.

The objective tests we used revealed differences between relatively large groups of age-matched children; but, because of the large inherent variation, even between control children, the value of such tests on individual children is generally limited. In the four children with impaired speech, whose clearance curves showed the greatest variation from the group curve, there did seem to be some relationship, however, between clearance and tongue skills.

JT had ankyloglossia and a mild degree of neural impairment. He had almost perfect control over tongue protrusion, but his other tongue skills were poorer than those of the group (Tables 4 and 6). His restricted tongue movement probably accounted for a very prolonged chewing time. A significant feature of GG was the very poor alignment of his teeth. This, together with poor tongue protrusion control, may have been responsible for the retention of sugar in the mouth after a relatively fast chewing time. LW exhibited a similar clearance curve, but in her case poor oral stereognosis may have made it difficult to remove small particles of toffee. A very poor tongue manipulation score may account for the delayed chewing time in GC.

Table 6 □ Tongue skills and chewing times in 4 children with impaired articulation who had significantly delayed toffee clearance times.

Subject	Oral-stereognosis error		Tongue tip manipulation	Tongue protrusion control error	Chewing time (sec)
	Number	Magnitude			
GC	5	7.0	1	3.56	255
GG	6	3.5	5	7.18	80
JT	9	13.0	2	0.24	485
LW	8	12.0	4	5.38	80

Many of these speech-impaired children, particularly the four whose clearance curves are shown in Figure 3, are at high risk to dental caries, if they regularly eat sticky fermentable carbohydrates. They have high sugar levels in the mouth for long periods.

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These studies depended on the cooperation of many teachers, head-teachers, speech therapists and above all the children. We appreciate the help they so willingly gave. We also thank Ron Shew and the personnel in both the Biometrics laboratory of the Dental School and the Computer Centre of The London Hospital Medical College for their assistance. The financial support given to one of us (M.A.M.) by the Saudi Arabian Government is gratefully acknowledged.

Subjective signs of efficacious inferior alveolar nerve block in children

Clinic

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Joel H. Berg, DDS, MS
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One of the most difficult tasks for the dentist inexperienced with restorative dentistry for children is in obtaining an efficacious inferior alveolar nerve block (IANB). The major problem in using the IANB is in adequately identifying an efficacious block before commencing treatment. Most commonly, the dentist uses lip numbness as a subjective sign to indicate a sufficient block of the ipsilateral inferior alveolar nerve. Some use soft tissue percussion tests (i.e., palpating the facial marginal gingiva mesial to the canine) to indicate profound IANB.[1] In such cases, if touching the soft tissue with an explorer elicits a proprioceptive response without a painful response, pulpal anesthesia of the quadrant is assumed.[2] Others use the sign of numbness of the tongue as an indicator that lingual nerve block and IANB have been obtained.[3]

Difficulty in obtaining IANB in children has been reported for several reasons. First, the dentist often administers a long buccal nerve block injection immediately after the IANB injection. This can superimpose the signs associated with the later injection upon the former, and provide a false sign of an efficacious IANB.[4] In the case where anesthesia of the primary anterior teeth is desired, an ineffective IANB may be

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perceived, but only as a result of cross innervation by the mylohyoid nerve.[5] Another likely explanation for difficulty in obtaining IANB in children is a result of the failure to recognize the changing position of the mandibular foramen with age.[6,7]

For these and other reasons, the inexperienced dentist can have greater difficulty obtaining inferior nerve block in children than in adults. The purpose of this study was to examine the relationship between commonly used subjective clinical signs of IANB in children with subsequent determination of profound inferior nerve anesthesia in children.

MATERIALS AND METHODS

Forty subjects were enrolled in the study. The subjects were not randomly selected (as each patient was his own control), but were included in the study, if they met the inclusion criteria (between the ages of three and eleven with a primary mandibular molar to be restored). Subjects were patients of the Department of Pediatric Dentistry, assigned to dental students for treatment. Informed consent was obtained from the parent before participation in the study, and assent was obtained from the child. Each subject had previously received a completed treatment plan for treatment involving mandibular primary teeth.

The mandibular quadrant to receive treatment was termed the treatment side, and the contralateral quadrant was termed the control side. Baseline and subsequent data sets were recorded on the treatment (ipsilateral) and control (contralateral) sides as follows.

- ☐ The gingival papilla mesial to the canine was stimulated with an explorer by applying mild lingually directed pressure. The patient's response of "yes" or "no" was recorded as indicative of feeling or not feeling the stimulus.
- ☐ The patient was asked whether he felt numbness in the tongue on both the ipsilateral and contralateral sides, and was asked to corroborate such statement by pointing out any distinctions by touching with a finger.
- ☐ The patient was asked whether he felt numbness in the lip on both the ipsilateral and contralateral sides, and was asked to corroborate such statement by pointing out any distinctions by touching with a finger.
- ☐ Ice was placed on the primary tooth to be treated, and on the same tooth in the contralateral quadrant. The patient was previously instructed to indicate by raising the hand when "cold" was felt on the tooth. A digital stopwatch was used to record the time required for the patient to indicate a cold perception on the ipsilateral and contralateral teeth.

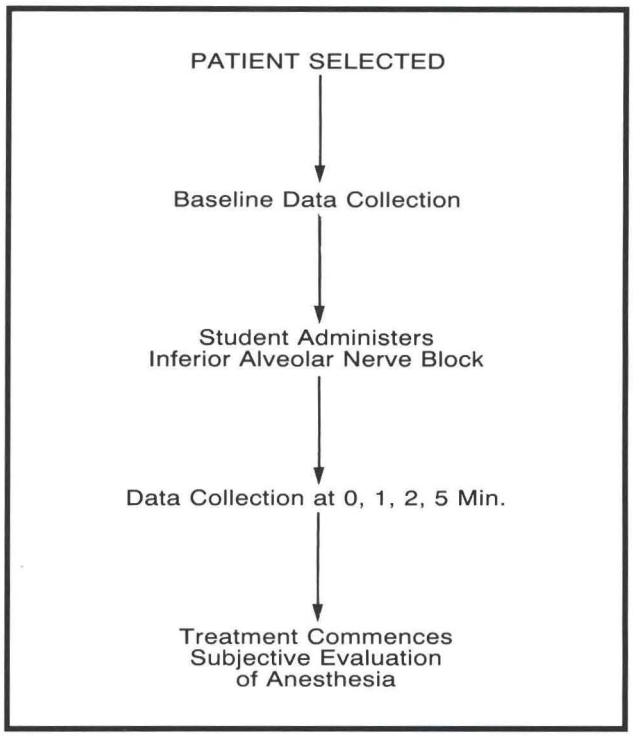

Figure 1. Flow chart demonstrating treatment technique.

The above data set was recorded for each subject before injection of anesthetic, immediately after administration of the anesthetic, one minute later, two minutes after injection and five minutes after injection (Figure 1).

Injection technique was provided verbally to the student before injection. The needle was introduced between the ramus of the mandible and the pterygomandibular raphe so that the syringe hub was directed at a point originating from the opposite second primary molar. The needle was passed through the soft tissue with an entry point near the occlusal plane in height until contact with the mandible was detected. The needle was then slightly withdrawn and redirected posteriorly, whereupon the needle would terminate about two thirds the distance from the anterior to the posterior border of the mandibular ramus.[8] After careful aspiration and examination, 1 ml of 2 percent lidocaine* with 1:100,000 epinephrine was deposited over a period of one minute. During the last fifteen seconds, or about the last 0.25 ml, the needle was slowly withdrawn from the tissue while depositing the remainder of the solution.

*Xylocaine - Astra Pharmaceuticals, USA.

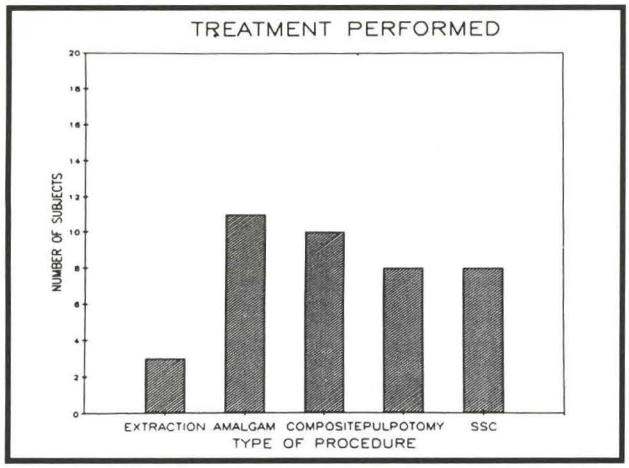

Figure 2. Types of treatment performed.

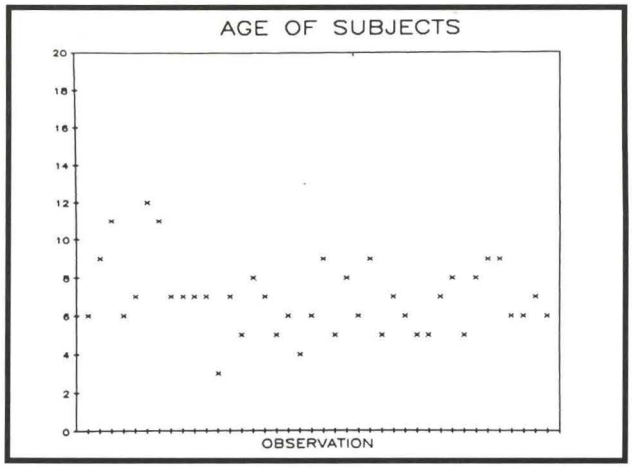

Figure 3. Age of subjects (scatterplot distribution).

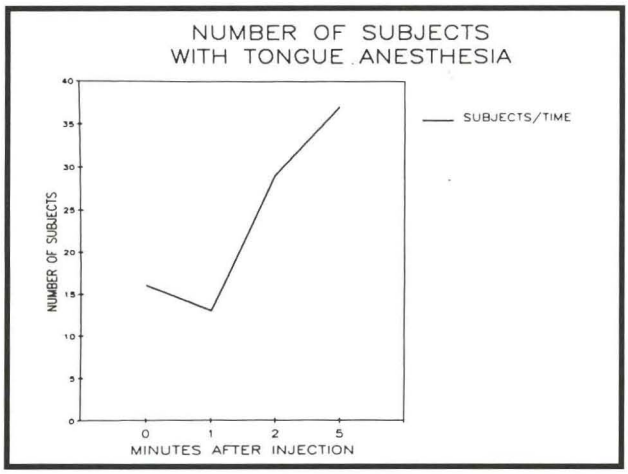

Figure 4. Number of subjects reporting tongue anesthesia versus time after injection.

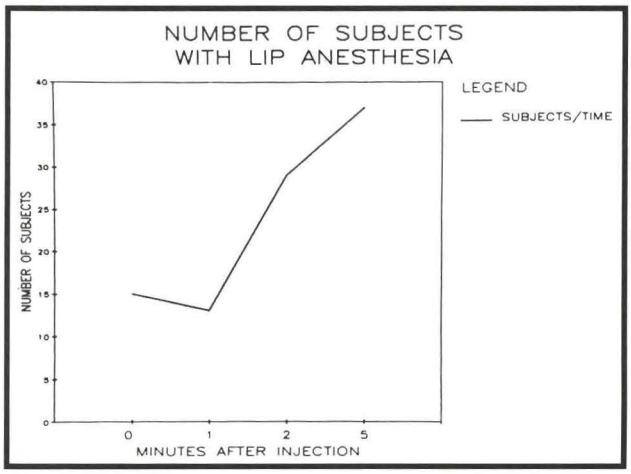

Figure 5. Number of subjects with lip anesthesia versus time after injection.

After injection, the remainder of the data sets were recorded. Treatment of the tooth did not commence until five minutes transpired (to allow experimental recordings), and only after verification of an efficacious IANB as determined by the signs recorded in this study.

The patients were also instructed to indicate any symptoms or signs of anesthesia by stating what was felt after administration of the anesthetic. In spite of this, no subject reported anything other than those sensations recorded as part of the data sets in the study.

RESULTS

Forty subjects were completed in the study, all of whom received either pulpotomies, amalgam restorations, composite resin restorations, extractions, or stainless steel crowns (Figure 2). The mean age of the subjects was seven years, with a range of three to eleven years (Figure 3).

Immediately after injection, sixteen of the forty subjects reported a change in tongue sensation on the ipsilateral side. One minute after injection, only thirteen reported such a difference in sensation between the two sides of the tip of the tongue. Two minutes after injection, thirty of the forty subjects reported distinct tongue numbness on the ipsilateral side, and this number rose to thirty-eight of the forty subjects by five minutes after injection (Figure 4).

An indication of a numb lip (positive lip sign) was recorded in fifteen of the forty subjects immediately after injection. There was a decrease to only thirteen of these subjects reporting lip numbness one minute after injection, as there was with the tongue sign. The number of subjects reporting a change in the lip on the ipsilateral side increased at the two- and five-minute time-periods after injection to twenty-nine and thirty-eight, respectively (Figure 5).

The number of subjects not responding (positive gingival test) to stimulation of the ipsilateral gingival test site was fourteen immediately after injection. There was a steady increase of subjects reporting no response (positive gingival test) at one, two, and five minutes after injection. Thirty-nine of the forty subjects reported no gingival responsiveness five minutes after

injections on the ipsilateral side with maintenance of responsiveness on the contralateral side (Figure 6).

Subjects with a positive tongue sign five minutes after injection were the same subjects as those with a positive lip sign. These were in turn the same subjects as those with the loss of gingival sensation, plus one other.

The ice test did not identify any notable difference in response from the subjects between the ipsilateral and contralateral sides over the entire experimental period.

All subjects with all three signs had no difficulty with subsequent treatment in terms of a perceived lack of anesthesia.

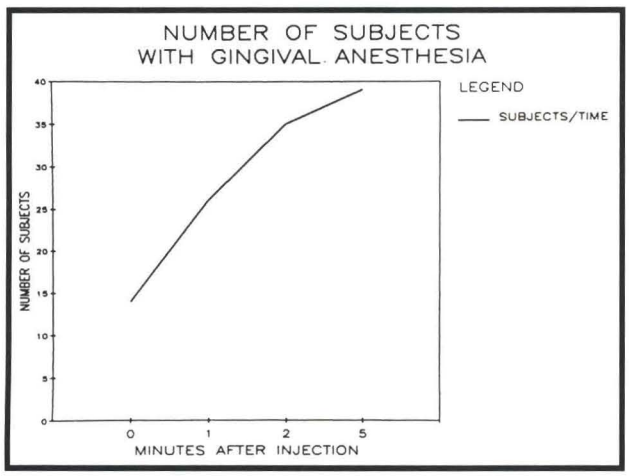

Figure 6. Number of subjects with gingival anesthesia versus time after injection.

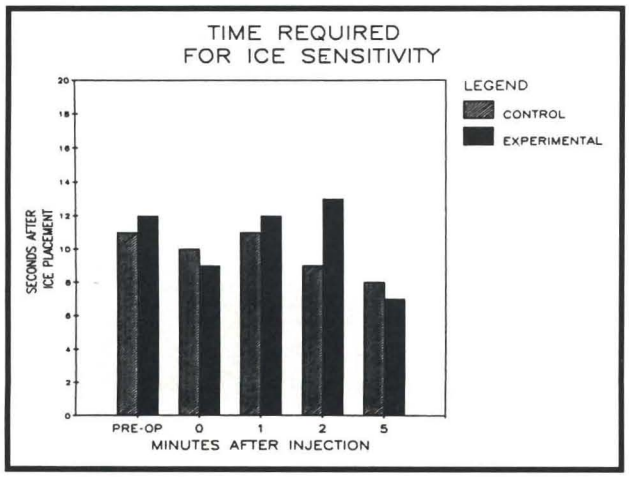

Figure 7. Number of seconds required for reporting of sensitivity to ice after placement of ice on control and treatment quadrants.

DISCUSSION

This study was designed to illustrate clinical signs indicative of profound anesthesia in the primary dentition, using the inferior alveolar nerve block injection. Whereas there are reliable tests for adequate anesthesia of the permanent mandibular teeth (e.g., percussion, thermal and electrical stimulation), there are few documentable reliable tests for the primary mandibular teeth (el-Hak, 1971).

The standard test used by most dentists in evaluating primary-mandibular-tooth anesthesia via the IANB is loss of sensation in the tongue and lip on the ipsilateral side.[10,11] There is lack of documentation demonstrating that these signs are completely effective. Even if they are in most cases, the present study showed that in some patients, there may be a loss of a positive tongue or lip sign shortly after administering the injection, with a need to wait at least two minutes after injection before capturing the majority of responders.

The present study indicates the loss of response of the gingival (positive gingival test) as more rapid result to IANB than the tongue and lip signs. The most reliable indicator of an efficacious IANB is perhaps a combination of the three signs (tongue, lip and gingiva).

Thermal response did not provide any information regarding the onset of anesthesia within the inferior alveolar nerve in the present study. Camp previously documented the unreliability of responsiveness to cold as an indicator of IANB in children.[12]

The inferior alveolar nerve provides sensory innervation to the mandibular primary teeth, as well as to the soft tissues facial to these teeth. Failures in IANB may be a result of failure to saturate adequately the entire inferior alveolar nerve trunk. This would suggest that even with the execution of the appropriate technique, it would be possible not to obtain a complete IANB, merely by virtue of insufficient nerve trunk penetration.[13] This is a possible explanation for those cases in the present study (two in number) where at least two of the three soft tissue signs were not present. Milles described improper technique as the most likely cause of ineffective IANB.[14] Whether or not this is true in children is unclear.

In conclusion, the present study found that response to ice was not a reliable indicator of inferior alveolar nerve anesthesia in children. Tongue and lip signs, although delayed in onset, were highly correlated with subjective anesthesia. There was an immediate significant correlation between the loss of gingival sensation (positive gingival sign) and the inferior alveolar nerve anesthesia, which became progressively more preva-

The most reliable indicator of a successful inferior alveolar nerve block is numbness of the tongue, lip, and gingiva.

lent throughout the five-minute, postinjection, experimental period.

Whereas the soft tissue facial to the mandibular primary molars is innervated by the inferior alveolar nerve, it is recommended that the clinician use the gingival sign test to determine adequacy of inferior alveolar nerve block before other injections are made, and before treatment is begun.

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CHILDREN AT RISK

Concerns about the functioning of children with chronic health conditions and their quality of life have been heightened by recent increases in the prevalence of chronic childhood conditions, in many cases because of improved survival rates. The human immunodeficiency virus epidemic is now contributing substantially to the chronically ill population of children, and further increases are expected.

Gortmaker, S.L. *et al*: Chronic conditions, socioeconomic risks, and behavioral problems in children and adolescents. Pediatrics, 85:267-276, March 1990.

Chlorhexidine as an oral hygiene adjunct for cyclosporine-induced gingival hyperplasia

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There are many causes for generalized hypertrophy of gingival tissues. These include genetic, idiopathic, hormonal, inflammatory, and iatrogenic causes.[1-3] Iatrogenic hyperplasia is a side-effect of certain specific drugs. Historically, phenytoin has been the most widely studied.[4] If left unchecked, gingival hyperplasia becomes unsightly and may interfere with occlusion.[5] Further, it can cause tooth displacement and masticatory inefficiency.[6]

In recent years, other drugs have been implicated in gingival hyperplasia. These include nifedepine, a drug prescribed as an antianginal, calcium channel blocker, and cyclosporine, an immunosuppressant agent used most commonly in organ transplantation.[7-11] There is recent documentation in the literature of several cases of cyclosporine-induced gingival hyperplasia.[12-19] Patient age, when documented, has ranged from fifteen to sixty-eight years. With one notable exception, all cases presented have been of patients with permanent dentitions.[20]

The current treatment of choice for severe gingival hyperplasia is surgical removal of the hypertrophic tissue.[6] It is currently thought that the hyperplasia is due to an exaggerated response to plaque, causing an overgrowth of fibroblasts and can be at least partially controlled, therefore, with a good oral hygiene program of plaque removal.[2,21]

A drug recently available in the United States for oral use, chlorhexidine gluconate, has proven to be effective in *in vitro* plaque control as well as in *in vivo* plaque reduction.[22,23]

The purpose of this article is to review the pharmacology of both the immunosuppressant cyclosporine and the plaque inhibitor chlorhexidine, as well as add a report to the literature on the possible effects of both of these drugs on a three-year-old patient.

CYCLOSPORINE

Cyclosporine is indicated for prophylaxis against organ rejection in kidney, liver and heart allogeneic transplantation. It is most often administered in conjunction with adrenal corticosteroids. Cyclosporine is also indicated for the treatment of chronic rejection in patients previously treated with other immunosuppressive agents. It has been used with some success in pancreatic, bone marrow, and heart-lung transplantations.[24] Much of the enthusiasm for liver transplantation has been attributed to the introduction of cyclosporine into clinical use.[25-27] Cyclosporine is usually prescribed with prednisone (adrenal corticosteroid), but not with other immunosuppressive agents, due to the synergistic effect of increased susceptibility to infection and

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lymphoma development.[24] The therapeutic advantage of combining cyclosporine and prednisone is that these drugs act at different sites in preventing activation of the rejection cascade.[25,28] This medical management has improved overall graft survival and has also reduced the frequency of acute graft rejection.

Patients on cyclosporine must have their blood levels constantly monitored to avoid toxicity due to high levels, and possible organ rejection due to low absorption of the drug. Nephrotoxicity is clearly the most important side-effect of cyclosporine management. This is a significant problem with the frequent occurrence of end-stage liver disease associated with renal failure. Some transplantation units regard preexisting renal failure as a contraindication to liver transplantation, and it has been suggested that azathioprine be used in the early posttransplantation period due to its renal sparing effect; cyclosporine would be introduced later.[29-31] All centers must modify the dosage of cyclosporine in an attempt to regulate the narrow pathway between renal failure and graft rejection.[29] As has been previously mentioned, the oral finding of gingival hyperplasia is also a side-effect of patients on cyclosporine therapy.[26,27,32]

Although increased patient survival has been attributed to the use of cyclosporine, patients less than eighteen years of age have longer survival rates.[33,34] With improvements in surgical techniques, graft preservation and immunosuppression, one-year survival rates following hepatic transplantation are now nearly 80 percent and five-year survival rates are expected to reach 60 percent.[29]

In pediatric patients, cyclosporine does not affect growth and development, whereas steroidal therapy does. There have been minimal side-effects with patients as young as six months of age, although guidelines in childhood are not consistently established.

The combination of cyclosporine and prednisone with azathioprine is the current chemotherapeutic regimen of immunosuppression used at the Medical College of Virginia for pediatric liver transplantation.

CHLORHEXIDINE

Chlorhexidine gluconate has been shown to be active against gram-positive and gram-negative organisms, facultative anaerobes, aerobes, yeast and fungi. It is known that the agent inhibits the formation of *in vitro* plaque, and also reduces viable salivary bacteria. Reduction of salivary bacteria varies with length of time rinsing is conducted.[35]

Chlorhexidine appears to be a potent suppressor of *streptococcus mutans*, which has been associated with the cause of dental caries. Studies that dealt with the anticariogenic potential of chlorhexidine have proven this relationship; outcomes, however, were influenced by duration of use, frequency of use, gel versus liquid form, mechanical cleaning procedures, and research model.[35]

Chlorhexidine is effective in reducing gingivitis, gingival bleeding, and plaque accumulation.

Although chlorhexidine has been shown to be ineffective in reducing subgingival plaque levels in pockets of 3 mm or more, it is most effective in reducing gingivitis, gingival bleeding, and plaque accumulation compared to a placebo.[36,37] Use of chlorhexidine has been shown to reduce significantly the number of microorganisms in the mouth. Shepherd has suggested this application for use in leukemics.[38] Other authors have suggested its use for patient groups that have difficulty performing conventional hygiene measures or who are at risk for bleeding or infection, such as during chemotherapy and bone marrow transplantation.[39] Side effects of chlorhexidine use include extrinsic staining of the dentition, composite restorations, and tongue. Stain may be removed by conventional means.[40]

Chlorhexidine does not decrease gingival hyperplasia in patients who are at risk for this secondary effect of drug therapy.[40] Its potential to prevent plaque formation and gingivitis, and eliminate a wide range of bacterial and fungal organisms makes it a valuable adjunct for use in organ transplant and other immunocompromised individuals.

CASE REPORT

A three-year, one-month-old black male presented for an initial visit to the Pediatric Dental Clinic of the

Figure 1. Cyclosporine-induced gingival hyperplasia previous to gingivectomy.

Figure 2. Patient following gingivectomy, one week postoperatively.

VCU/MCV School of Dentistry. The chief complaint was his inability to eat solid foods. Medical history included extrahepatic biliary atresia, for which the patient received a liver transplant at eighteen months of age.*

Medications at the time of the initial appointment included cyclosporine 180 mgs every 12 hours and prednisone 4 mgs once a day. Intraoral examination revealed severe generalized gingival hyperplasia. All primary teeth were present. Because of the severity of the gingival overgrowth, however, maxillary teeth were not visible, with the exception of the central incisors. In the mandibular arch, the first primary molars were the only teeth minimally involved. The remainder of the crowns were either completely overgrown with gingival tissue or very severely involved (Figure 1). The patient's mother stated that before cyclosporine therapy was begun, the erupted teeth were free of gingival overgrowth.

A full-mouth gingivectomy was decided upon, and the surgical procedure was completed without complications. One week postoperatively, all gingival tissues appeared to be healing well, all crowns were fully exposed, and there was no report of discomfort (Figure 2).

It was decided to place the patient on a three-month recall and to emphasize good oral hygiene, to minimize recurrence of the gingival hyperplasia. Because of the patient's age, it was determined that self-brushing for effective plaque removal would be impossible. The patient's mother was also concerned about her proficiency in brushing the child's teeth. After ascertaining

Figure 3. Same patient as in Figure 2, following chlorhexidine therapy, six months postoperatively.

the child's ability to swish and expectorate, a decision was made to place the patient on a 15 ml chlorhexidine mouth rinse, BID, after meals, as adjunctive therapy. Although normally not recommended for young children, given the severity of the gingival hyperplasia and the patient's immunocompromised state, it was felt that the potential benefits would outweigh the possible risks in this case. Toothbrushing instruction was given to the mother as well as instruction on the importance of a plaque-free oral environment. The parent was advised to attempt to brush her child's teeth, doing as good a job as possible.

At the six-month recall-appointment, the patient was asymptomatic, eating regularly and with minimal recurrence of hyperplastic tissue, this primarily on the facial surface of the lateral incisors (Figure 3). One year postoperatively, the patient presented with slightly more inflamed gingival tissues, mostly on the facial, mesial, and lingual surfaces of the maxillary right central incisor, the facial surface of the maxillary left central incisor, the facial surface of the mandibular right lateral incisor and the interproximal area between the right mandibular lateral incisor and canine (Figure 4). At the

*Surgical procedures previously described-See References, Svirsky, J.A.; Saravia, M.E.: Dental management of patients after liver transplantation.

Figure 4. Same patient as in Figure 2, one year postoperatively.

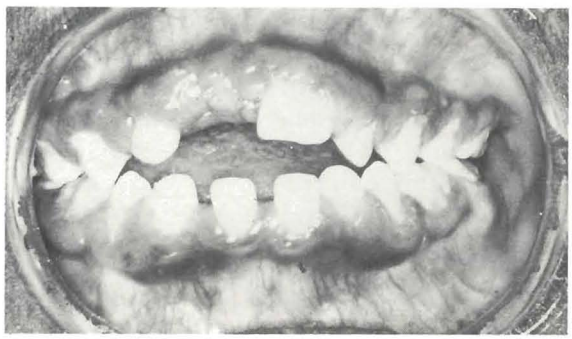

Figure 5. Twenty-four months postoperatively.

24-month follow-up examination, the gingival pattern is basically unchanged, or slightly improved. Noteworthy is the premature loss of tooth E, avulsed during a playful "wrestling match" with his older sister (Figure 5). There has been no significant tooth discoloration and the patient has adjusted well to the daily regimen.

DISCUSSION

With current advances in surgical technique and drug therapy, organ transplantation has become a much more successful procedure, especially in the pediatric population. Immunosuppressive therapy has contributed greatly to the success of organ transplants; one of the major drugs is cyclosporine. As described earlier, cyclosporine is well documented in the literature as being a causative factor, in some cases, of gingival overgrowth. Dental plaque has been implicated as a major contributor in this hyperplastic phenomenon. The documented plaque-reduction properties of chlorhexidine would lead one to believe that elimination of plaque in cyclosporine-dependent patients may contribute to the arrest of reduction of gingival hyperplasia in this special population. In the case of this particular patient, taking into account the mother's report, it is apparent that there was a causal relationship between the beginning of immunosuppressive therapy and gingival overgrowth. An assumption could be made that cyclosporine therapy and dental plaque combined to cause directly or contribute significantly to the gingival hyperplasia.

The attenuation of overgrowth following gingivectomy is not as clear. Following the surgical procedure, there was a marked reduction in tissue, which has remained stable for over twenty-four months. Possibly, surgical exposure of the involved teeth combined with improved oral hygiene may have been sufficient in preventing new growth. Since the patient was immediately placed on a chlorhexidine regimen following surgery, it is impossible to ascertain whether surgery alone was responsible for the improved condition. Judging from the existing literature, however, it would seem unlikely that surgery alone without chemical plaque reduction would have led to the observed results.

The reduction in plaque, moreover, may have been due to factors other than chlorhexidine therapy. Also to be considered would be an improvement in the child's proficiency in mechanical plaque removal as well as the mother's ability to assist the child in this effort. Given the child's age and observation of child, and lack of maternal proficiency in brushing, it was determined that these were not likely causative factors in this particular case.

Another confounding variable seen here (and in transplantation cases in general) is ongoing changes in the drug-therapy regimen. The toxic effects of cyclosporine are well known; inherent, therefore, in cyclosporine therapy is the need to maintain dosages at lowest possible blood levels that will still provide maximal therapeutic effect. In this particular case, at the start of chlorhexidine therapy, the patient was receiving 180 mgs of cyclosporine twice daily. The dosage has been reduced to 80 mgs BID, with a corresponding reduction in chlorhexidine rinses to one per day. This overall reduction in cyclosporine dose may also have played a role in the decrease of gingival overgrowth.

Although the effects of chlorhexidine in contributing to this apparent cessation are not completely clear, it is felt that discontinuation "to see what would happen" is not in the patient's best interest. Discontinuation of the rinse might lead to a return of hyperplastic tissue, perhaps requiring surgery; certainly not an acceptable option.

Although chlorhexidine appears to be the controlling factor in the diminution of the hyperplastic response,

it is obvious that there are several potentially confounding variables. Clearly, further controlled study is needed in the areas of oral hygiene, mechanical and chemical plaque removal, and dose-related effects of immunosuppressive therapy on gingival tissues.

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Assessment of a 2 percent buffered glutaraldehyde solution in pulpotomized primary teeth of schoolchildren

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Several reports recently demonstrated the negative effects of formocresol, and the need to find a medicament to replace it as a pulp dressing material became imperative.[1-6]

Glutaraldehyde has been proposed as a possible substitute for formocresol after pulpotomies in primary teeth; because it is a fixative, its effect is similar to that of formocresol; it is believed, however, to be less toxic.[7] This assumption was initially demonstrated by *in vitro* investigations, followed by studies in laboratory animals, utilizing either normal or inflamed pulps.[8-10] The efficacy of this medicament was also demonstrated in human clinical trials.[11,12]

The present study reports the clinical and radiographic assessment of the effect of glutaraldehyde as a pulp dressing in pulpotomized, cariously exposed human primary molars, twenty-five months after treatment.

MATERIALS AND METHODS

Thirty-two children (thirteen boys and nineteen girls), with an average age of seven years, participated in the study. These children, all of them second-graders, were selected from a rough screening that took place in the classrooms; those who had large lesions, received priority for treatment. This selection, which was also made to prevent eventual need for premature extractions of several teeth, enabled us to perform a relatively large number of pulpotomies in a short period of time. Pulpotomies were performed in fifty-three primary molars, and their distribution is presented in Table 1.

The criteria for selection of the teeth to be treated were similar to those utilized in a previous study, when diluted formocresol was used as a pulp dressing.[13] These included:

- ☐ Symptomless exposure of vital pulp by caries.
- ☐ No clinical or radiographic evidence of pulp degeneration.
- ☐ The possibility of proper restoration.

Table 1 ☐ Distribution of teeth treated with glutaraldehyde pulpotomy.

	Upper	Lower	Total
First primary molar	13	17	30
Second primary molar	11	12	23
Total	24	29	53

Dr. Bimstein and Dr. Fuks are associate professors; Dr. Guelmann was a post-graduate student and is presently with the Israeli Air Force; and Dr. Klein was a clinical senior lecturer (now retired) in the Department of Pedodontics, The Hebrew University-Hadassah Faculty of Dental Medicine.

Pulpotomy technique

All pulpotomies were performed by the senior authors (A.F., E.B. and H.K.), following a previously established protocol that called for:

- ☐ Administration of a local anesthetic and placement of rubber dam.
- ☐ Preparation for a stainless steel crown.
- ☐ Complete removal of caries.
- ☐ Opening of the pulp chamber with a 330 tungsten bur in a high speed turbine.
- ☐ Amputation of the coronal pulp with the same bur.
- ☐ Placement of a dry cotton pellet moistened in a 2 percent buffered glutaraldehyde solution for five minutes.
- ☐ Removal of cotton pellet and placement of a zinc-oxide eugenol paste over the pulp stumps.
- ☐ Restoration of the tooth with a stainless steel crown.

A 2 percent buffered glutaraldehyde solution was freshly prepared for this study, by diluting a 25 percent stock solution in distilled water and 0.2 M sodium phosphate buffer (pH 8.0), as proposed by Ranly.[14]

Clinical and radiographic follow-up was made six, twelve, and twenty-five months after treatment. Treatment was considered a failure when one or more of the following signs was present: internal root resorption, furcation and/or periapical bone destruction, pain, swelling, or sinus tract.

The degree of root resorption of the treated teeth and their antimeres was evaluated according to criteria established by Wright *et al*, in which root resorption is assessed in three degrees:

- ☐ One or more roots near complete resorption.
- ☐ One or more roots, resorption within mid-third of roots.
- ☐ Less than a third resorption of any root.

All radiographs were examined concomitantly by two authors. In case of disagreement or suspicion of pathosis, the most severe diagnosis was recorded.

Table 2 ☐ Failure rate of pulpotomized primary teeth of school children utilizing a 2 percent glutaraldehyde solution.

	Clinical and radiographic status		
	Number of teeth examined	Failure	
Follow up time		Number	Percent
Six months	53	3	5.7
Twelve months	52	5	9.6
Twenty-five months	50	9	18.0

RESULTS

All the treated teeth were examined six months after treatment, and fifty teeth were assessed at the twelve- and twenty-five-month recalls. At the last examination six teeth had exfoliated and two had been extracted. One child did not appear for examination.

Tables 2 and 3 present the failure rate and the radiographic findings six, twelve, and twenty-five months after treatment. The failure rate increased from 5.7 percent at the six-month evaluation to 18 percent after twenty-five months.

Internal resorption was observed in a total of six teeth; two of them were diagnosed as early as six months after treatment, another two at the twelve-month check-up, and the last two at the twenty-five-month examination (Figure 1). One of these teeth, in addition to this finding had a periapical and interradicular pathosis; an additional tooth presented an interradicular radiolucency at the twenty-five-month examination. External re-

The number of teeth with normal pulp decreased from 49 teeth at the six-month examination to 15 at the final observation.

sorption was found in only one tooth. Pulp canal obliteration, which was not listed as a failure, was observed in one tooth after six months, reaching a total of twenty teeth at the final examination (Figure 2). The number of teeth with normal pulp decreased considerably from forty-nine teeth at the six-month examination to only fifteen at the final observation.

The resorption rate of the pulpotomized molars as compared to their antimeres, twenty-five months post-treatment, is presented in Table 4. In most of them (82.6 percent), the resorption rate was similar; and in seven teeth (15.2 percent), the pulpotomized teeth resorbed faster than their controls (Figures 3a and 3b).

DISCUSSION

Previous clinical studies utilizing glutaraldehyde as a pulp medicament in human primary teeth, reported success rates higher than 90 percent; in the present report, 18 percent of the treated teeth were listed as failures twenty-five months after treatment (Table 2).[11,12] A similar decrease in the success rate was described by Rolling and Thylstrup, using formocresol as a pulp dressing agent.[16] Both studies suggest that the use of fixative materials such as formocresol and glutaraldehyde, do not promote pulp healing.

In a three-year study utilizing Buckley's solution, Rolling and Lambjerg-Hansen also reported a decrease in clinical success.[17] Not a single case of internal resorption, however, was evident. A small percentage of internal resorption (1.4 percent) was found when diluted formocresol was utilized.[13] Conversely, Hicks reported internal resorption occurring in over 10 percent of the cases, utilizing a modified formocresol technique, in which this medicament was incorporated in the zinc-oxide-eugenol paste only, avoiding the five-minute application to the pulp stumps.[18] The relatively high percentage of internal resorption in the present

Figure 1. Radiograph of a pulpotomized lower first primary molar at the twelve-month examination. A large area of internal root resorption is evident at the distal root and a similar, but smaller area at the mesial root.

Figure 2. Mandibular first primary molar twenty-five months after pulpotomy with a 2 percent buffered glutaraldehyde solution. Note the almost complete obliteration of both root canals.

Table 3 ☐ Effect of 2 percent glutaraldehyde on pulpotomized primary teeth of schoolchildren: radiographic findings.

Radiographic findings	Six months	Twelve months	Twenty-five months	Totals N	Totals %
Inter-radicular pathosis	1*	–	1	2*	4
Periapical radiolucency	1*	–	–	1*	2
Internal resorption	2*	2	2	6*	12
Pulp canal obliteration	1	4	15	20	40
External resorption	1	–	–	1	2
Normal pulp	49	43	15	15	33.3
Number of teeth examined	53	52	50	50**	

* two teeth presented several pathologic findings.
** this number includes six exfoliated and two extracted teeth.
N = number of teeth.

Table 4 ☐ Resorption rate of pulpotomized molars as compared to their antimeres.

	N	%
Same as antimere	38	82.6
Faster than antimere	7	15.2
Slower than antimere	1	2.2
Total number of pairs	46*	100.0

* Four pulpotomized teeth had no antimeres

investigation (12 percent) might be related to the histologic status of the radicular pulp. In a study where inflammation was limited to the coronal pulp, no difference could be observed between pulpotomized teeth in monkeys with normal or inflamed pulps.[10] The criteria for selection of cases, in the present study, called for teeth without clinical or radiographic signs of pulp degeneration. All the teeth presented a carious exposure, however, and in some, the radicular pulp might have been inflamed. Despite the high correlation demonstrated between the type of bleeding and indication for pulpotomy, there is no means of precisely determining clinically the status of the pulp tissue in the root canals.[19] The application of the glutaraldehyde solution over a chronically inflamed pulp might have been the main reason for causing internal resorption in some teeth. This assumption is reinforced by the fact that other factors that could lead to internal resorption were prevented: the pulpotomy technique utilized was gentle, and pulp amputation was performed with high speed; in addition, the glutaraldehyde solution was freshly prepared and kept refrigerated.[14,20] Garcia Godoy, in a clinical study utilizing a 2 percent glutaraldehyde solution for one to three minutes in primary teeth, did not report internal resorption.[12] The difference in the findings between the latter and the present study may be the result of a longer time of application of the glutaraldehyde over the pulp stumps and/or, the buffering of the solution in the present study.

The potential risk for internal resorption is increased in teeth where the predentin is lacking.[21] The physiologic process of shedding of the primary teeth occurs in areas lacking an odontoblastic layer as well as the absence of predentin, because of odontoblastic activity.[22] These facts may predispose the primary teeth to pathological internal resorption.

Obliteration of the root canal following formocresol pulpotomy was reported using either the conventional or a 2 percent dilution of Buckley's solution.[13,18,23] This calcific metamorphosis is apparently the result of increased odontoblastic activity following formocresol pulpotomy. It was demonstrated that dentin formation occurred normally in unaffected tissue, even when formaldehyde was utilized.[17] The high percentages of pulp canal obliteration (60 percent) described by Hicks *et al* with formocresol, and the one observed in the present study, at the twenty-five-month checkup (40 percent), may be the result of exaggerated odontoblastic activity, eventually due to irritation caused by the two fixatives on a chronically inflamed radicular pulp.[18]

Relatively high percentages of periapical and furcation radiolucent areas were reported, utilizing the conventional Buckley's solution.[2] Lower percentages were observed by Fuks and Bimstein using a 20-percent solution of formocresol, by Garcia-Godoy using glutaraldehyde, and in the present study.[12,13]

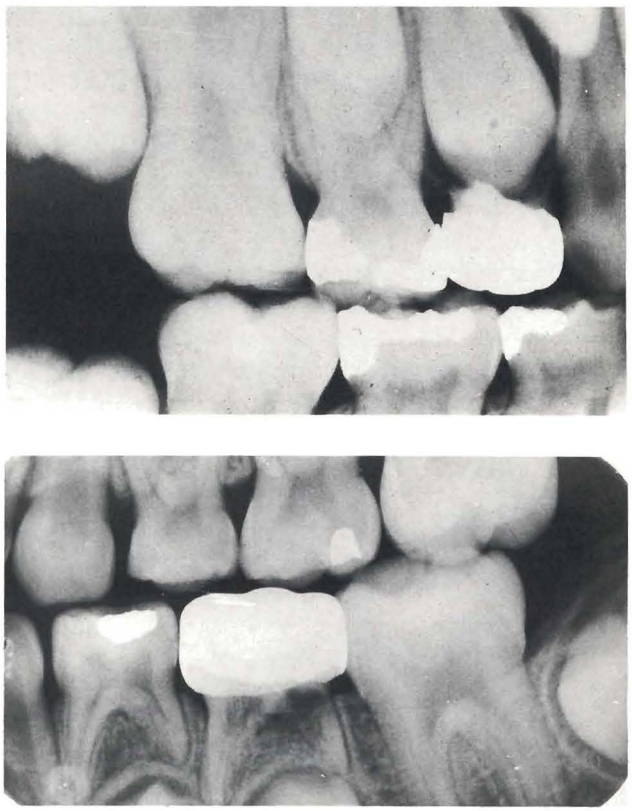

Figure 3. Radiographs of a pulpotomized maxillary first primary molar (above) and its antimere (below). The roots of the pulpotomized tooth are almost completely resorbed and the permanent successor is close to eruption, while the roots of the antimere are resorbed to a lesser extent.

Exfoliation of pulpotomized molars was observed to occur faster than their antimeres in 47.2 percent of the teeth, when the formocresol was incorporated in the paste only; a smaller percentage (39 percent) was reported when a 20 percent diluted formocresol was used.[13,18] Only 15.2 percent of the teeth resorbed faster than their controls in the present study, and this may be considered an advantage of glutaraldehyde over formocresol. This difference might be explained by the limited fixation caused by glutaraldehyde, because of its cross-linking properties; whereas formocresol has been shown to have extrapulpal toxicity.[6,7]

CONCLUSION

The relatively high failure rate (18 percent) observed after pulpotomy using a 2 percent, buffered glutaral-

dehyde solution does not justify recommending it as a substitute for formocresol. Further research using different concentrations of glutaraldehyde and/or times and means of its application may produce better clinical results.

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CHRONIC ACID-BASE DISTURBANCES

Because of the effects of urinary pH on the efficiency with which the kidneys remove fluoride from the body, it would be expected that chronic acid-base disturbances could have important effects on fluoride balance and tissue concentrations. Factors that can chronically alter acid-based status include the composition of the diet, which is normally the major determinant of acid-base status and urinary pH, certain drugs, a variety of metabolic and respiratory disorders, the level of physical activity and the altitude of residence. Chronic acid-base disturbances associated with any of these causes could affect not only the balance of fluoride but also the cariostatic efficacy of given amounts of ingested fluoride as well as the susceptibility to dental fluorosis.

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Clinical and histologic findings of the dentition in a hypopituitary patient: report of case

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David E. Steflik, MA, EdD
Baldev Singh, BDS, MS, PhD
William H. Hoffman, MD

Idiopathic hypopituitarism is associated with delayed dental eruption as well as malocclusion and delayed growth of the dentofacial complex.[1] Both maxillary and mandibular growth can be affected, although mandibular growth is usually more severely affected because of a short ramus.[2]

Although growth-hormone-deficient children may have retarded dentitions, the delay in dental age is neither as great nor as common as the delay in skeletal age.[3,4] Delayed exfoliation of primary teeth has also been reported.[5] Hamori examined tooth size in four growth-hormone-deficient children and reported a difference in crown robustness; Bevis reported, however, that the dentition was of normal size.[2,5,6]

In addition, there have been several reports of morphologic changes and dysplasias in the dentitions of growth-hormone-deficient children; reports of enamel histopathologic alterations, however, are limited.[5-7] We describe in this paper the clinical dental findings and histologic findings related to enamel maturation in the permanent dentition of a hypopituitary male.

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CASE HISTORY

The patient was fifteen years, eleven months of age and was seen in the Pediatric Endocrine Clinic at the Medical College of Georgia for evaluation of his short stature. The medical history revealed the patient was always the shortest in his class and the discrepancy increased over the last several years. The family history was unremarkable. Pertinent physical findings revealed the following: A height of 136.2 cm (<5th centile); weight of 44 kg (<5th centile); and genitalia Tanner stage P_1 and G_2. Laboratory data consisted of a serum thyroxine of 5.7 μg/dl (low); a serum testosterone of 9 ng/dl (prepubertal); serum calcium of 11.3 mg/dl and serum phosphorous of 4.7 mg/dl; and an abnormal growth hormone response to an arginine-clonidine tolerance test (maximum response of 3 ng/ml) when euthyroid. Bone age by Gruelich and Pyle was 11.5 years.[8]

The patient was referred to the orthodontic clinic for evaluation of malocclusion. The dental history was noncontributory; it showed eruption of the first primary tooth at nine months of age. Dental examination revealed a full permanent dentition with unerupted third molars. No enamel hypoplasia was evident. Dental age,

determined from a panoramic radiograph, was appropriate for his chronological age (Figure 1). Severe gingivitis, heavy formations of calculus, and minimally attached gingiva affected the mandibular incisors. The patient's malocclusion was characterized by a severe tooth-size, arch-length discrepancy, resulting in 9 mm of crowding in the maxillary arch; the canines were labial to the arch-form. The molar relationship was Class II on the right and Class I on the left. The right lateral incisor was in linguoversion, and in cross-bite; and there was distal rotation of the left lateral incisor. The mandibular arch had 7.7 mm of crowding with distal tipping of the lateral incisors and rotations of the left first premolar and first molar. Cephalometric evaluation was normal; the etiology of the malocclusion, therefore, was a tooth-size arch-length discrepancy.

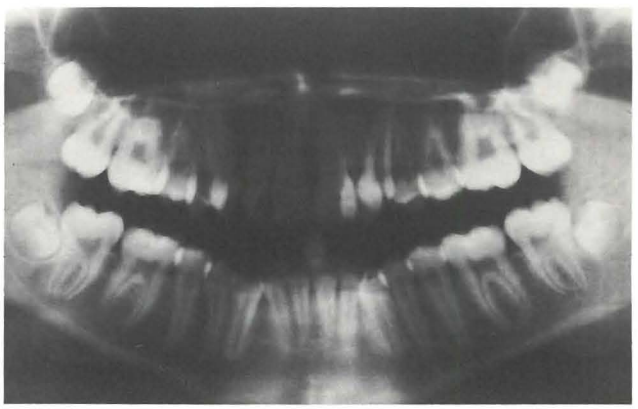

Figure 1. Panoramic radiograph of patient.

MATERIALS AND METHODS

Medical Intervention

The patient, at 16.25 years began treatment for hypopituitarism. Medications included 5 mg of somatotropin three times weekly and L-thyroxine 75 μ/day. During the first six months of treatment, his increase in height was 6.4 centimeters. At age seventeen, he reached a height of 147.6 cm, weight of 43.4 kg, genitalia Tanner stage P_2 and G_4, and a bone-age of thirteen years.

Dental intervention

After orthodontic consultation, complete orthodontic records were made, which included models, photographs, full-mouth and cephalometric radiographs. The patient was referred to his local dentist for completion of preventive and restorative needs, and to the pediatric dental clinic for removal of the maxillary right lateral incisor, maxillary left first premolar, and the mandibular right and left first premolars. Subsequent to the removal of the teeth, the patient began comprehensive orthodontic treatment in February 1987.

Immediately following removal, the premolar teeth were fixed by immersion in 10 percent phosphate buffered formalin for forty-eight hours. The teeth were dehydrated in increasing concentrations of ethanol, transferred to acetone and embedded in polymethyl methacrylate. Sections were cut in a coronal-optical plane at 100 to 150 micrometers with a Buehler Isomet low-speed saw affixed with a diamond wafering blade. Control premolar teeth from a patient who had a height appropriate for chronological age were handled in the same manner. The sections were polished and placed

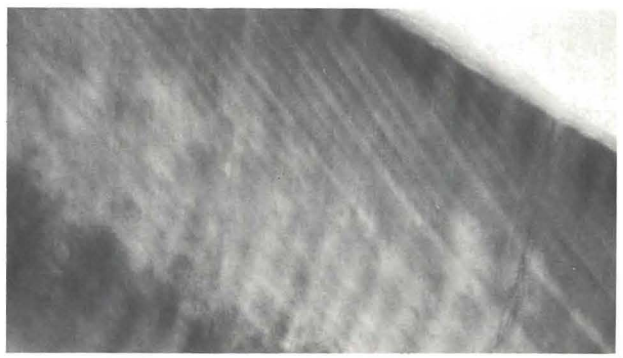

Figure 2. Photomicrograph of control premolar, using polarized light and showing uniform patterns of enamel calcification. (Original magnification x 28).

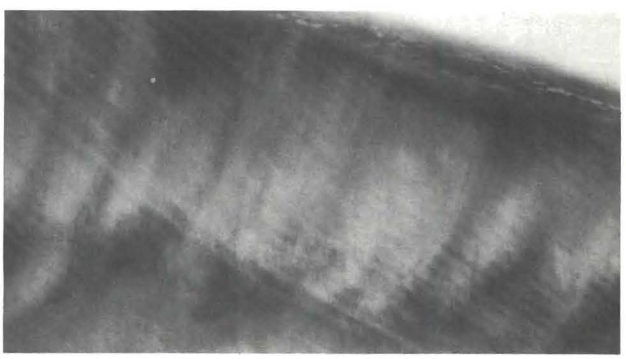

Figure 3. Photomicrograph of patient's premolar, using polarized light. Note variable patterns of enamel calcification and increased number and prominence of lines of Retzius. (Original magnification x 28).

on Buehler petrographic well slides and coverslipped, using permount mounting media.[9] The slides were viewed with a Zeiss photomicroscope using both rou-

Hypopituitarism affects the maturation of enamel.

tine and polarized light sources. Kodak tungsten 50 film was used to record images.

RESULTS AND DISCUSSION

An anabolic effect of growth hormone has been well-documented by balance studies and by the effect on body composition.[10,11] Although the most striking effect of growth hormone is on linear growth, its role in the mineral content of bone has also been demonstrated in growth hormone deficiency.[12] Until this report, however, only Dahllof reported histologic studies of a primary molar of a 2.5-year-old child with congenital hypopituitarism.[7] Ground sections showed enamel hypoplasia and hypomineralization, involving both lingual and buccal surfaces with a surface zone of minimal dysplasia and an unaffected zone at the dentinoenamel junction.[7] Our patient, unlike Dahllof's, did not experience symptoms of hypoglycemia in the newborn period nor exhibit clinical evidence of enamel hypoplasia, suggesting a less severe degree of both hypopituitarism and enamel hypoplasia.

Lines of Retzius normally are depicted as brownish striations, which, according to Osborn and Cate, reflect the phasic nature of enamel formation and its response to systemic influence.[13] Avery reports that these lines represent changes in enamel growth, accentuated by disease and changes in nutrition.[14] A few narrow lines are expected; numerous lines or broad bands, however, suggest disturbances during enamel formation and represent areas of hypocalcification. Polarized light microscopy of control teeth (Figure 2) showed uniform patterns of enamel calcification. Polarized light microscopy of our patient's premolar, however, consistently exhibited varying densities that reflect zones of differential mineral content indicative of hypocalcification (Figure 3). Such an appearance is consistent with hypocalcification secondary to growth-hormone-deficiency; a role for thyroid deficiency, however, cannot be ruled out.[15] No histologic changes were observed in the dentin and cementum of our patient's teeth. Although extensive radiographs of the long bones were not taken, it is important to note that the radiograph of our patient's wrist revealed no Harris lines.[16] Whether there is any relationship between the lines of increased density seen in the radiographs of long bones in patients who sustain interruption of linear growth, and the variability of calcification of the dentition seen in our patient and that reported by Dahllof is unknown.[7]

It is important to note that Purvis suggested a threshold for plasma calcium in neonates below which enamel hypoplasia develops, and another report indicated a correlation between an early age of onset of hypocalcemia and the development of enamel hypoplasia.[17,18] While our patient was relatively old to be diagnosed as growth-hormone-deficient, the calcification of the permanent teeth studied, which begins at approximately 2.5 years, almost certainly occurred during a growth-hormone-deficient period.

The significant tooth-size, arch-length discrepancy in our patient may have been accentuated by the late age at which growth hormone deficiency was diagnosed and his relatively normal dental eruption. This finding would be in keeping with the discrepancy between our patient's dental age and bone-age.

The histologic differential in enamel calcification as well as the variability in the pattern of lines of Retzius in our patient's teeth, supports both clinical and laboratory reports that hypopituitarism affects the maturation of enamel.[7,19] More recently Wongsurawat demonstrated a modulating role for growth hormone in the renal metabolism of 25-hydroxycholecalciferol.[20] That factors other than growth hormone and/or somatomedin - C are involved in enamel calcification is suggested, however, by the fact that neither our patient nor any of Sarnat's nineteen patients with idiopathic growth-hormone-deficiency had clinical evidence of enamel hypoplasia.[21]

Our report extends the hypothesized endocrine etiologies for enamel hypoplasia to permanent as well as primary dentition. It also emphasizes the need for evaluation of patients with enamel hypoplasia and/or tooth-size, arch-length discrepancy to include a clinical assessment of linear growth. If patients are below the

The authors gratefully acknowledge the assistance of Dr. Mary A. Ready in the care of this patient.

fifth centile in height and growing at less than five centimeters per year, they should be referred for endocrine evaluation.

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LOW BIRTH WEIGHT

Low birth weight is a major determinant of infant mortality. A low-birth-weight infant is almost 40 times more likely to die in the first four weeks of life as a normal-birth-weight infant, and two thirds of all deaths during the first month are attributable to low birth weight. Researchers recently demonstrated a sixfold increase in the risk of low birth weight associated with financial problems during pregnancy after controlling for differences in ethnicity, health habits, and complication of pregnancy. The presence of low birth weight, in addition to increasing the risk of mortality, can have major consequences for those who survive. These infants appear to be at increased risk of serious illness, developmental disorders, and life-long handicapping conditions. Birth defects, mental retardation, seizure disorders, and cerebral palsy are more prevalent among these infants. The most distressing fact is that low birth weight and its consequence for infant mortality and health is largely a preventable disorder. According to the Department of Health and Human Services, with adequate risk assessment, 80 percent of women at risk of having a low-birth-weight baby can be identified at the first prenatal visit, and intervention can be started to reduce the risk.

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Demography

Are minority children getting their fair share of dental services?

H. Barry Waldman, BA, DDS, MPH, PhD

A changing pattern of dental disease and increasing use of dental services have been the themes of any number of professional and consumer publications during the decade of the 1980s. As a result of the continued emphasis on the decreases in dental caries, lay observers may feel that sometime in the not-too-distant future, dental caries will be relegated to the status of an occasional nuisance and that dental practitioners have, or soon will have, the ability to restore any and all carious lesions.

NATIONAL CARIES STUDIES

The reality is that despite the many changes, half the children in our country continue to have dental caries and many children in our communities are in need of operative dental services. That's the finding from the recently published report on the 1986-87 national survey of dental caries in U.S. school children; an update of the 1979-80 national survey.*[1,2]

In the 1986-87 school year, a multistage probability sample was drawn with eventually more than 39 thousand children between five and seventeen years (representing the 43 million children in these age-groups) examined throughout the United States, except in the State of Alaska.

The following presentation will review the 1979-80 and 1986-87 studies in terms of the dental status of,

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and services received by minority and nonminority children. This information will be compared to other relevant reports on dental-visit patterns and the availability of dental insurance.

DENTAL DISEASE

Caries

During the 1980s, the mean decayed (D), missing (M), filled (F), teeth (T) and surface (S) rates for permanent teeth** of children of all ages and races decreased. Changes developed, however, in the relationship of the DMFT and DMFS rates between minority and nonminority children. In 1979-80, nonminority children had higher DMFT and DMFS rates than their minority counterparts. By 1986-87, this relationship had reversed, with minority children having higher rates than nonminority children, particularly for DMFS rates. The change occurred as a result of marked decreases in the rates for nonminority children and smaller decreases in the rates for minority children (Table 1).

The changes in the relationships between minority and nonminority children during the two periods were comparable for both males and females (Table 2).

In addition to the general national averages for minority and nonminority children, the 1986-87 report provided information about the two population groups for seven different regions of the country. Wide variations between regions were reported for the mean DMFT and DMFS rates for minority and nonminority children. Higher DMFT and DMFS rates for nonminority children were reported for Region I (New England) and lower rates in Region V (Southwest). For minority children, higher rates were reported in Region VII (Pacific) and lower rates in Region I (New England) (Table 3).

Periodontal disease

Gingival health was evaluated for eighth-through-twelfth-grade children, as determined by the presence or absence of gingival bleeding on gentle probing of buccal and mesial sites of twenty-eight permanent teeth. More than 11,000 children between fourteen and seventeen years of age were examined. The findings included:

- ☐ At least one bleeding site was found in 58.8 percent of the children; decreasing slightly with increasing age.
- ☐ Gingival bleeding occurred in 61.5 percent of males and 56.6 percent of females.
- ☐ Gingival bleeding occurred in 55.1 percent of white children and 72.1 percent of nonwhite children.
- ☐ Mean percent of bleeding sites for white children was 5.2; for nonwhite children, 8.0.[3]

Table 1 ☐ Mean decayed (D), missing (M) and filled (F) permanent teeth (T) and surface (S) by age and race: 1979-80 and 1986-1987.[1,2]

	Mean DMFT			
	1979-1980		1986-1987	
Age	White	Black & all others	White	Black & all others
5	.08	.06	.04	.07
6	.16	.16	.09	.11
7	.44	.40	.28	.34
8	.92	.80	.52	.48
9	1.32	.91	.75	.82
10	1.74	1.45	1.06	1.28
11	2.04	1.55	1.54	1.43
12	2.77	1.97	1.73	2.03
13	3.48	2.87	2.41	2.43
14	4.16	3.43	3.05	3.03
15	5.11	3.99	3.65	3.70
16	5.62	5.07	4.18	4.23
17	6.60	4.85	4.86	5.33
All	3.03	2.29	1.97	1.99
	Mean DMFS			
5	.12	.08	.06	.11
6	.20	.20	.12	.16
7	.59	.55	.38	.46
8	1.26	1.19	.72	.66
9	1.99	1.44	1.09	1.32
10	2.64	2.43	1.54	2.14
11	3.11	2.45	2.31	2.38
12	4.32	3.46	2.48	3.35
13	5.45	5.22	3.62	4.23
14	6.43	6.02	4.48	5.31
15	8.25	7.09	5.53	6.27
16	9.57	9.66	6.54	7.19
17	11.24	9.85	7.63	9.63
All	4.89	4.15	2.97	3.40

Table 2 ☐ Mean decayed (D), missing (M) and filled (F) permanent teeth (T) and surface (S), by gender and race: 1979-80 and 1986-1987.[1,2]

	Mean DMFT			
	1979-1980		1986-1987	
Gender	White	Black & all others	White	Black & all others
Male	2.82	2.09	1.82	1.84
Female	3.26	2.50	2.11	2.16
	Mean DMFS			
Male	4.57	3.79	2.73	3.12
Female	5.24	4.50	3.21	3.69

*It should be noted that because of the examination criteria used in these studies, all findings are apt to be conservative compared to those that would be expected from routine examinations performed in a dental office.[2]

**Data comparisons in this presentation are only for the status of the permanent dentition of children between five and seventeen years of age. Data presentation in the survey reports on primary dentitions and by different places of residence (i.e., standard metropolitan statistical areas vs. more rural areas) were not categorized in terms of minority and nonminority status.

At least one bleeding site was found in 58.8 percent of the children.

Future reports on the data from the 1986-87 study will emphasize other phases of existing dental disease patterns.[4]

RECEIPT OF DENTAL SERVICES

The receipt of dental health services may be measured by a variety of methods, including the frequency and number of visits, and the types of services provided (e.g., preventive services vs. restorative services). For purposes of this review, the receipt of services will be evaluated in terms of 1) the ratio of the filled (F) rate to the total DMFT and DMFS rates (i.e., percent F/DMFT and percent F/DMFS); 2) percent of children with a dental visit in the past year; 3) number of visits per child; and 4) percent of children whose last dental visit was for a "check-up."

The filled ratio

Between 1979-80 and 1986-87, the percent F/DMFT and F/DMFS increased for minority and nonminority children. In both examination periods, minority children in all age-categories, however, had lower filled ratios than their nonminority counterparts. By 1986-87, minority children still had lower filled ratios than nonminority children had in 1979-80 (Table 4).

The changes in the F/DMFT and F/DMFS ratios between minority and nonminority children during the two periods were comparable for both males and females (Table 5).

Once again, on a regional basis, there were marked differences in rates. The F/DMFT and F/DMFS ratio for nonminority children ranged from 80.5 percent in Region IV (Southeast) to 93.1 percent in Region VII (Pacific). Comparable ratios for minority children in these two regions were 56.4 percent and 86.2 percent, respectively (Table 3).

Table 3 □ Mean decayed (D), missing (M) and filled (F) permanent teeth (T) and surface (S), and percent filled by race and region: 1986-1987.[2]

	Mean DMFT		Percent F/DMFT	
Region*	White	Black & all others	White	Black & all others
I	2.35	1.67	88.4%	82.8%
II	2.22	2.11	86.6	68.7
III	1.99	1.80	91.8	81.4
IV	2.07	1.83	80.5	58.5
V	1.53	1.72	86.3	65.9
VI	1.82	1.74	89.5	82.2
VII	1.82	2.75	92.0	86.2
National	1.97	1.99	87.5	69.5
	Mean DMFS		Percent F/DMFS	
I	3.66	2.56	87.2%	79.1%
II	3.33	3.61	86.6	66.2
III	2.91	2.92	91.0	79.8
IV	3.07	3.11	80.5	56.4
V	2.26	2.97	86.6	61.8
VI	2.75	2.81	89.7	80.2
VII	3.00	4.88	93.1	82.5
National	2.97	3.40	87.5	67.0

*Region	States	Region	States
I	CT,MA,ME,NH,RI,NH	V	AZ,CO,NM,TX
II	NJ,NY,PA	VI	ID,KS,MT,NB,ND,NV,OK,SD,UT,WY
III	IN,IL,IA,MI,MN,MO,OH,WI	VII	CA,OR,WA
IV	AL,AK,DE,FL,GA,KY,LA,MD, MS,NC,SC,TN,VA,WV		

Table 4 ☐ Percent filled (F) of mean decayed (D), missing (M) and filled (F) permanent teeth (T) and surface (S) by age and race: 1979-80 and 1986-1987.[1,2]

Age	1979-1980 White	1979-1980 Black & all others	1986-1987 White	1986-1987 Black & all others
	Percent F/DMFT			
5	35.6%	0.0%	23.8%	33.3%
6	43.3	38.7	45.9	71.3
7	61.3	39.1	61.7	64.0
8	69.3	57.0	73.4	63.3
9	76.4	56.4	77.7	65.7
10	75.8	62.5	81.3	68.0
11	78.9	54.0	85.4	68.3
12	79.5	56.6	84.0	64.9
13	79.8	54.5	85.9	64.4
14	79.7	63.0	89.2	70.6
15	84.3	50.9	88.0	71.6
16	84.5	61.2	91.1	73.2
17	86.9	55.3	92.4	71.4
All	81.8	56.7	87.5	69.6
	Percent F/DMFS			
5	40.3%	0.0%	21.2%	38.5%
6	50.2	41.0	52.7	79.9
7	64.8	45.0	67.0	67.0
8	71.2	60.3	75.7	68.6
9	77.7	56.3	78.9	65.1
10	75.4	60.8	82.2	68.3
11	79.1	53.7	85.6	65.5
12	79.4	52.2	84.4	62.1
13	78.1	51.5	85.6	61.8
14	77.3	56.4	89.1	67.5
15	82.4	43.8	87.4	70.6
16	81.6	52.1	90.4	70.0
17	84.1	44.3	91.6	65.7
All	80.3	50.4	87.5	67.0

Table 5 ☐ Percent filled (F) of mean decayed (D), missing (M) and filled (F) permanent teeth (T) and surface (S) by gender and race: 1979-80 and 1986-1987.[1,2]

Gender	1979-1980 White	1979-1980 Black & all others	1986-1987 White	1986-1987 Black & all others
	Percent F/DMFT			
Male	80.8%	52.5%	86.9%	68.5%
Female	82.8	60.2	88.1	70.6
	Percent F/DMFS			
Male	79.8%	46.8%	87.9%	66.0%
Female	80.8	53.3	87.0	67.9

Table 6 ☐ Children's dental visit pattern in previous year by age and race: 1986.[6]

Age	Percent with visit	Number of visits per child
2-4 yrs.		
White	32.1%	0.7
Black*	26.0	0.6**
5-11 yrs.		
White	73.4	2.2
Black*	57.2	0.9
12-17 yrs.		
White	72.9	2.9
Black*	54.6	2.0

*Does not include "all others" (i.e. Aleut, Eskimo or American Indian, Asian American, Pacific Islander and any other races)
**More than 30 percent relative standard error in numerator of rate

Dental visit in the past year

In 1986, in all age-categories, a smaller percentage of minority children than nonminority children visited a dentist in the previous year. The differences between the two population groups increased with age (Table 6).

Number of visits

Again, in 1986, in all age-categories, minority children had fewer number of dental visits per child than their nonminority counterparts (Table 6).

Dental "check-up"

In 1986, for all age-groups, dental insurance was a factor in the use of dental services. A greater percentage of children with private dental insurance and reported visits and more visits per child than their uninsured counterparts.† A smaller percentage of minority children in all age-groups, as compared to their nonmi-

†For a more detailed presentation on the relationship between the use of dental services by children and the availability of insurance, see a previous report by this writer in the *Journal of Dentistry for Children.*[5]

Table 7 ☐ Percent of children with dental insurance by race and ethnicity: 1986.[6]

Race & ethnicity	Age		
	2-4 yrs.	5-11 yrs.	12-17 yrs.
White	42.6%	45.6%	45.6%
Black	26.1	28.3	30.2
Hispanic			
Mexican Amer.	36.8	29.8	36.8
Other	28.4	31.9	33.0

Table 8 ☐ Children's dental insurance status by reason for last visit and race: 1986.[6]

	Age			
	2-4 yrs.		5-17 yrs.	
	Insurance	No Insurance	Insurance	No Insurance
Last dental visit was for a "check-up"				
White	32.5%	22.9%	62.5%	46.3%
Black*	24.0	19.2	54.2	35.1

*Does not include "all others" (i.e. Aleut, Eskimo or American Indian, Asian American, Pacific Islander and any other races)

nority counterparts, had dental insurance (Table 7). Reflecting these differences, it was reported that, as compared to their nonminority counterparts, for a smaller percentage of minority children (with and without dental insurance) the last dental visit was a "check-up" (Table 8).

Finally, in 1983 (the last period for which national data are available), black children between two and eleven years of age, had fewer visits to pediatric dentists than their white counterparts.‡

FAIR SHARE?

Minority and nonminority children continue to need dental services. Nonminority children have more of their service needs met than their minority counterparts. In some regions in the nation, large segments of the young minority population are not receiving needed dental services. And minority children have fewer visits for dental services with a smaller percentage of the visits for preventive "check-ups" than nonminority children. These are some of the findings from the national surveys of the 1980s.

Few dental practitioners (or even the general community) would be surprised with these findings. The continued relationship between family economics, education levels, dental insurance, the adequacy of government funding for dental programs, and the availability and use of dental services has been documented repeatedly.

The need is to continue to present such findings to legislators and funding agencies. The need is for the general public to recognize the reality that dental caries "has not been relegated to the status of an occasional nuisance"—especially for minority children. Or, are we so certain of the economic viability of pediatric dentistry that we may overlook minority children?

‡For a more detailed presentation on the question "who uses the services of pediatric dentists?" see a previous report by this writer in the *Journal of Dentistry for Children.*[7]

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Selecting a location for the practice of pediatric dentistry

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CHANGING NUMBERS OF PEDIATRIC DENTISTS

In the United States, between 1979 and 1987, the number of children increased by 1.6 percent (from 62,566,000 to 63,542,000).[1] During this same period, the number of pediatric dentists increased by 73.9 percent (from 1,776 to 3,089).[2,3] Nationally, the ratio of pediatric dentists per population of children (younger than eighteen years of age) increased from 2.8 to 4.9 pediatric dentists per 100,000 children.

STATE-BY-STATE COMPARISONS

Despite the major national increase in the number of pediatric dentists, in 1987, on a state-by-state basis, there were wide variations in:

- ☐ *The number of pediatric dentists*: From three pediatric dentists in the State of North Dakota, and four in each of the States of South Dakota and Wyoming, to 222 in the State of Texas and 411 in the State of California.
- ☐ *The ratio of pediatric dentists per population of children*: From 1.6 and 1.8 pediatric dentists per 100,000 children, respectively, in the States of North Dakota and West Virginia, to 9.4 and 12.5 pediatric dentists per 100,000 children, respectively, in the State of Connecticut and the District of Columbia (Table 1).*

Despite the increasing numbers of pediatric dentists per population of children and changing dental disease patterns, the professional activities and financial return of practice have continued to improve. This transformation in the practice of pediatric dentistry has resulted from an increasing use of dental services by a wider population base, as well as a changing pattern of practice.**

Note: State-by-state comparisons of the distribution of pediatric dentists are possible for particular years as a result of the periodic reports on the number of specialists published by the American Dental Association (specifically for years 1976, 1979, 1982, 1987). Although comparisons between 1979 and 1987 are being used in this presentation because of the particular increases in the numbers of pediatric dentists during this overall period, in reality between 1982 and 1987, there was a general slowdown in the "production" of pedia-

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*For a discussion of the varying numeric increases of pediatric dentists during the 1980s, see an earlier presentation in the *Journal of Dentistry for Children.*[5]

**For an extended discussion of the changing and improving environment for pediatric dental practice, see an earlier series of presentations in the *Journal of Dentistry for Children.*[6-9]

Table 1 ☐ Number of pediatric dentists, pediatric dentists per 100,000 children less than 18 years and dental establishment net income by state: 1979, 1987.[1-4]

	Number of pediatric dentists		Number pediatric dentists per 100,000 children < 18 years		Dental establishment net income (in thousands)
	1979	1987	1979	1987	1987
Alabama	36	60	3.2	5.4	$ 78.6
Alaska	0	8	0.0	4.7	113.3
Arkansas	13	24	2.0	3.7	84.9
Arizona	21	34	2.8	3.7	68.7
California	315	411	5.1	5.6	96.7
Colorado	39	55	4.9	6.3	74.8
Connecticut	27	71	3.3	9.4	98.3
Delaware	4	9	2.4	5.6	116.2
Dist. of Columbia	6	17	3.6	12.5	81.1
Florida	78	137	3.5	5.1	93.9
Georgia	47	84	3.0	4.8	92.2
Hawaii	7	27	2.6	9.4	89.2
Idaho	5	8	1.7	2.6	77.9
Illinois	75	112	2.3	3.7	79.2
Indiana	52	94	3.3	6.4	75.9
Iowa	34	43	4.1	5.9	67.3
Kansas	23	25	3.6	3.9	76.5
Kentucky	32	57	3.1	5.7	56.3
Louisiana	40	62	3.1	4.7	69.0
Maine	2	8	0.6	2.6	75.9
Maryland	32	77	2.8	6.8	84.7
Massachusetts	66	112	4.4	8.4	88.6
Michigan	59	81	2.2	3.3	90.9
Minnesota	26	40	2.2	3.6	85.0
Mississippi	7	23	0.9	2.9	67.0
Missouri	35	44	2.6	2.4	73.7
Montana	7	9	2.9	4.0	60.0
Nebraska	18	22	4.0	5.2	63.5
Nevada	8	9	3.9	3.6	101.5
New Hampshire	3	12	1.2	4.6	84.3
New Jersey	62	112	3.1	6.1	90.9
New Mexico	9	15	2.2	3.4	74.2
New York	88	208	1.9	4.8	82.4
North Carolina	35	61	2.2	3.8	86.6
North Dakota	1	3	0.5	1.6	70.8
Ohio	58	127	1.9	4.5	78.5
Oklahoma	22	36	2.7	4.0	70.7
Oregon	18	43	2.6	6.3	75.9
Pennsylvania	73	147	2.3	5.2	77.6
Rhode Island	6	13	2.4	5.7	94.0
South Carolina	20	37	2.2	3.9	79.7
South Dakota	2	4	0.9	2.0	68.5
Tennessee	38	74	3.0	5.9	71.6
Texas	93	222	2.3	4.5	79.6
Utah	6	14	1.2	2.2	65.2
Vermont	2	6	1.4	4.3	78.1
Virginia	28	67	1.9	4.6	82.0
Washington	57	63	5.2	5.4	90.0
West Virginia	6	9	1.1	1.8	67.8
Wisconsin	34	54	2.5	4.3	78.7
Wyoming		4	0.7	2.7	64.9
	,991				
United States	1,776	3,089	2.8	4.9	83.5

tric dentists. Between 1982 and 1987, there was an increase of only 4.7 percent in the national number of pediatric dentists (an increase of 140 pediatric dentists: from 2,949 to 3,089). "...At least on a macrogeographic basis, pediatric dental manpower appears to have established a level of equilibrium."[5]

IS IT POSSIBLE TO DETERMINE LOCATION FACTORS?

With the changing environment for dental practice and large increase in the number of pediatric dentists, it is important to develop an understanding of the decision-making process by which individuals select particular practice locations. Due to the complexity involved in this decision process, however, it is essential that specific guidelines for this effort be established. The decision to locate a dental practice and live in one region, state, community, street or even building, is based upon a highly complex series of personal, family, cultural, economic and a seemingly infinite series of other interrelated variables. As such, we will not address the review from a causal perspective, but will look at the "after-the-fact" relationships that apparently exist between the location of pediatric practitioners and various economic and social factors. It is possible that some individual practitioners may have considered these same variables before their decision to establish a dental practice in a particular location. In this sense, then, these factors could have influenced their decision.

Economic considerations

Although many factors, to a greater or lesser extent, have an impact on practice-location decisions, economic considerations are significant realities and are singled out, therefore, for further discussion. Data are now available through the late-1980s from the U.S. Department of Commerce and the American Dental Association, which permit a review of the general economics of dental practice on a state-by-state basis. Unfortunately, specific income data are not available on a state-by-state basis for pediatric dental practices. Considering the widespread overall improvement in dental practice current and constant dollar net income (i.e., removing the effects of inflation), however, it would seem reasonable to suggest that, to some degree, the improvements in the economics of dentistry include favorable developments in pediatric dental practice. Note: Reports from the American Academy of Pediatric Dentistry's recent study of pediatric dentist busyness indicate that:

- ☐ Seventy-four percent of pediatric dentists reported increased numbers of patients seeking care and increased numbers of patient visits.
- ☐ Twelve percent of pediatric dentists reported decreases in levels of practice activity.
- ☐ Only 3 percent of pediatric dentists reported their schedule of patients was "seriously deficient."[10]

Nationally, between 1982 and 1987, despite a decrease in the percent of net return from practice from 38.7 percent to 36.2 percent, the average current dollar net income per dental establishment† increased from $65.5 thousand to $83.5 thousand.‡ Constant dollar average net income increased from $67.9 thousand to $73.5 thousand. On a state-by-state basis, however:

- ☐ Between 1982 and 1987, constant dollar net income decreased in seven states (Alaska, Arizona, Hawaii, Iowa, Louisiana, North Dakota and Wyoming).
- ☐ In 1987, current dollar net income ranged from less than $65 thousand in the states of Kentucky, Montana, Nebraska and Wyoming to more than $100 thousand in the states of Delaware, Nevada, and Alaska (Table 1).

DETERMINING THE AFTER-THE-FACT RELATIONSHIPS

The Spearman Rank Order Test is used to determine the probability of agreement between rank-orderings of two sets of data.[12] Very low probabilities are interpreted to mean that the likelihood of two variables rank ordered (in this case, by state) did not occur by chance, and indicate a high degree of correlation (or significance), therefore, between the two variables. The meaning of this relationship must then be defined by the investigators in evaluating the statistical results.

Spearman Rank Order correlation procedures were conducted, comparing the ranking by state for the number of pediatric dentists per 100,000 children and ranking by state for 1) dental establishment net income, 2) per capita income, 3) per capita taxes, 4) expenditures per pupil in public elementary and secondary schools, 5) crime rate, 6) unemployment rate and 7) divorce rate.

It should be emphasized that a high correlation does not necessarily indicate a causal relationship between the variables. For example, there may be a high degree of correlation between an increase (over time) in the amount of acid rain and the number of soccer teams in the United States. Such examples could be referred to as "nonsense or spurious correlations." With these realities of correlation in mind, each of the variables in this study were considered in relation to the number of pediatric dentists per population.

There were significant correlations between the number of pediatric dentists per population of children and five of the seven variables:

- ☐ Dental establishment net income $p = .02$
- ☐ Per capita income $p < .01$
- ☐ Per capita tax $p < .01$
- ☐ Expenditures per pupil $p < .01$
- ☐ Crime rate $p = .02$

There were no significant correlations between the number of pediatric dentists and two of the variables:

- ☐ Unemployment rate $p = .22$
- ☐ Divorce rate $p = .72$ (Table 2)

VALUE OF SUCH FINDINGS

It is tempting to hypothesize "attraction relationships" between the ratio of the number of pediatric dentists per population of children and dental establishment

†An establishment is a single physical location where business is conducted or where services are performed. It is not necessarily identical with a firm, which may consist of one or more establishments.

‡The net return from practice was developed using U.S. Department of Commerce dental practice business-receipt information. The net-to-gross ratios were based on nationwide ADA data for solo dental practice. No doubt, there were variations by region and state for net return from practice (as well as cost-of-living differences). By comparing 1982 and 1987 data, to some degree a constancy by state is maintained. See a previous presentation for a detailed review of these data.[11]

net income, per capita income, expenditures per pupil, and the unfortunate attendant realities of per capita income taxes and crime rates.

Similarly, one could be tempted to hypothesize that, since pediatric dentists tend to provide service to children in more affluent families, there should be a limited relationship addressing the numbers of pediatric dentists and unemployment rates.[16]

As to the lack of a correlation between pediatric dentist to population ratios and divorce rates, it is possible (probable?) that such an attempt would be an example of a "nonsense correlation" as noted above.

Developing correlations between pediatric dentist/population ratios and a series of "retrospective" variables can be an initial step in developing a protocol for

Decisions on location of practice are often arrived at haphazardly.

Table 2 ☐ Rank order of number of pediatric dentists per 100,000 children, dental establishment net income, per capita income, expenditures per student, crime rate per 100,000 population, unemployment rate and divorce rate by state: 1984-1988.[1,3,4,13-15]

	Ratio pediatric dentists	Dental establishment net income	Per capita income	Per capita taxes	Expenditures per pupil*	Crime rate	Unemployment rate	Divorce rate
	1987	1987	1985	1986	1988	1988	1987	1984
Alabama	17	26	43	49	49	31	12	9
Alaska	24	2	2	1	1	25	2.5	3
Arkansas	36.5	42	48	50	51	36	10	7.5
Arizona	36.5	16	21	19	40	4	25.5	7.5
California	14	5	7	11	26	7	28	17
Colorado	7	35	9	20	17	12	13	15.5
Connecticut	3	4	1	5	5	23	48	41.5
Delaware	15	1	11	14	10	29	49.5	30
Dist. of Col.	1	21	na	2	6	1	23	27.5
Florida	20	7	13	36	16	2	34	6
Georgia	21	8	28	35	46	10	31.5	19
Hawaii	2	12	16	8	30	14	45.5	31.5
Idaho	47	29	45	48	47	41	11	12
Illinois	38	24	12	17	20	17	16	3.5
Indiana	6	32	30	39	35	38	20.5	14
Iowa	11	45	29	24	32	40	31.5	43.5
Kansas	34	31	20	28	19	26	37	19
Kentucky	12	51	44	46	38	47	6	31.5
Louisiana	23	41	40	37	41	15	1	50
Maine	46	33	38	25	18	45	40	24.5
Maryland	5	17	4	9	13	16	42	41.5
Massachusetts	4	13	5	6	8	24	49.5	51
Michigan	43	11	17	13	22	13	9	36.5
Minnesota	39	15	15	12	15	33	33	46
Mississippi	44	46	50	51	48	44	4	24.5
Missouri	41.5	37	27	43	36	28	23	24.5
Montana	32	50	42	29	24	34	16	19
Nebraska	12	49	22	30	34	39	37	38
Nevada	40	3	14	16	33	9	23	1
New Hampshire	25	18	10	41	27	46	51	21.5
New Jersey	9	10	3	7	2	21	44	39.5
New Mexico	39	36	41	38	31	8	5	2
New York	22	19	8	4	4	11	37	43.5
N. Carolina	35	14	36	40	28	27	39	29
N. Dakota	51	39	34	33	39	49	35	49
Ohio	27	27	24	26	25	25	18	24.5
Oklahoma	31	40	33	34	45	18	16	4
Oregon	8	34	31	23	14	6	25.5	15.5
Pennsylvania	19	30	26	22	9	48	29	48
Rhode Island	13	6	18	18	7	22	45.5	39.5
South Carolina	33	22	39	45	44	20	30	36.5
South Dakota	49	43	46	44	43	50	42	46
Tennessee	10	38	37	47	42	32	19	10
Texas	28	23	23	32	37	3	8	12
Utah	48	47	47	31	50	19	20.5	21.5
Vermont	29.5	28	35	21	12	35	36	33.5
Virginia	26	20	6	27	21	37	42	33.5
Washington	16	9	19	15	23	5	18	12
West Virginia	50	44	49	42	29	51	2.5	27.5
Wisconsin	29.5	25	25	10	11	42	27	46
Wyoming	45	48	32	3	3	43	7	5

*Per average daily attendance

an analysis of the location-decision process carried out by younger pediatric dentists. Such a research design could include:

- ☐ The straightforward query of, "why did you select a particular location?"
- ☐ Questions on the steps carried out by the practitioner in developing the needed information.
- ☐ Responses to a series of questions that were developed from preliminary retrospective studies.

This final set of "factors for correlation" could provide a more systematic review by providing a framework for the respondents.

An earlier presentation had suggested the continuing potential for the practice of pediatric dentistry in less urban settings.[17] But in general, limited attention has been directed to the process and difficulties in determining favorable pediatric dentistry practice locations (from both the practitioner and community perspective).

Recent graduates from pediatric training programs should be traced and questioned as they progress through the practice location decision process. Standard demographic data, together with more specific personal histories, needs and preferences, can provide a matrix for the series of variables developed by this and other retrospective studies of current practitioner locations. The practice location decision process is too important to be carried out in a haphazard manner by recent graduates from pediatric training programs. The successful (and not so successful) decisions could provide essential information for future program graduates.

In a time of dramatic changes in the delivery of dental services to children (as well as the general population) and wide swings in the numbers of dental practitioners, it would seem prudent to develop an understanding of this decision process that transcends: 1) the "after-the-fact" high probability of correlation between the ratio of pediatric dentists and the crime rate in a state; and 2) the low probability of a correlation with the divorce rate in a state.

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ABSTRACTS

de Soet, J.J.; Holbrook, W.P.; van Amerongen, W.E.; Schipper, E.; Hamburg, C.H.E.; de Graaff, J.: Prevalence of *Streptococcus sobrinus* in relation to dental caries in children from Iceland and The Netherlands. J Dent Child, 57:337-342, September-October, 1990.

The aim of this study was to investigate the presence of S. *sobrinus* and S. *mutans* in specimens of dental plaque and saliva of children five years of age in Reykjavik, Iceland (study 1) and in samples of dental plaque from children nine years of age in Amsterdam, The Netherlands (study 2). The immune-blotting technique (IBT) was a suitable method to evaluate the presence and numbers of S. *mutans* and S. *sobrinus* in human dental plaque and saliva. In study 1, eighty-four children were evaluated bacteriologically; of these, 73 percent harbored mutans streptococci in their plaque or saliva. S. *sobrinus* similarly was present in 29 percent of the children. In study 2 (seventy-two children), the corresponding percentages were 81 percent for S. *mutans*, and 35 percent for S. *sobrinus*. The latter was detected in 6 percent of the plaque samples exclusive of S. *mutans*.

Caries; Streptococci; ;*S. mutans*; *S. sobrinus*; Mouth, human

Pendrys, David G. and Morse, Douglas E.: Use of fluoride supplementation by children living in fluoridated communities. J Dent Child, 57:343-347, September-October, 1990.

As part of a case-control study that investigated risk factors of enamel fluorosis, a fluoride/residency history was obtained covering the first six years of life by means of a mailed questionnaire, with a reliability factor of 90 percent. Of the 677 participating seventh-grade and eighth-grade children, demonstrating either mild-to-moderate dental fluorosis (fluorosis cases) or were fluorosis-free (fluorosis controls), 11 percent (N = 74) had lived in a fluoridated community for at least a year during their first six years of life. Forty percent of the fluorosis cases and 22 percent of the fluorosis controls were reported to have taken fluoride supplements during their residency in a fluoridated community, with 79 percent of the supplementation for both groups in the form of vitamins with fluoride. Further, these children had resided in more than twenty cities across ten states, and therefore do not represent just a localized problem. Such findings indicate that fluoride supplements had been incorrectly prescribed for a sizeable percentage of children residing in fluoridated areas; they also suggest an explanation for the recent increased prevalence of fluorosis in similar age-groups in some fluoridated areas. Given that the recent literature does not show that the appropriateness of supplemental prescription practices has improved for post-1975 birth cohorts, these findings suggest the need for enhanced professional education and monitoring to ensure that this occurs.

Fluorosis; Community health; Water, fluoridated; Supplements, fluoride; Continuing education

Burrow, Michael F. and Makinson, Owen F.: Pits and fissures: remnant organic debris after acid-etching. J Dent Child, 57:348-351, September-October, 1990.

The purpose of this study was to compare the ability of liquid and gel etches to remove remaining debris in occlusal pits and fissures *in vitro* after cleansing using a conventional technique or air-water slurry method. A suitable stain differentiated between etched enamel, unetched enamel, and pellicle or debris. The results statistically indicate that etching does not remove much of the organic debris, and there was no difference between a liquid or gel etchant. Agitation of the etchant did not aid pellicle removal.

Fissure caries; Sealants; Acid-etching; Debris, organic; Enamel preparation; Prevention

Scoville, Ronald K.; Foreman, Frank; Burgess, John O.: *In vitro* fluoride uptake by enamel adjacent to a glass ionomer luting cement. J Dent Child, 57:352-355, September-October, 1990.

The release of fluoride from a glass ionomer luting agent used to cement an orthodontic band was shown to increase enamel fluoride levels of adjacent teeth *in vitro*. The fluoride uptake was statistically significant at gingival biopsy sites after one month. There was an inverse relationship between baseline fluoride levels of the biopsied teeth and the amount of fluoride taken up by the enamel.

Enamel; Uptake, fluoride; Orthodontics; Restoration, glass ionomer

Speirs, Ronald L. and Maktabi, M. Ayman: Tongue skills and clearance of toffee in two age-groups and in children with problems of speech articulation. J Dent Child, 57:356-360, September-October, 1990.

If children use the same tongue skills in swallowing and clearing remnants of sticky foods from the mouth as they do in articulating during speech, it could then be hypothesized that those with impaired articulation might have poorer tongue skills and, consequently, slower rates of food clearance. Does age alter these skills and rates of clearance? Measurements were made of oral stereognosis, tongue-tip manipulation skill, control of tongue protrusion, and the time taken to chew and swallow a standardized piece of toffee and to clear it from the mouth. A statistically significant improvement in tongue skills with age was observed when results for twenty-three 19- to 23-year-old students were compared with those for twenty-nine 6 to 11-year-old children, but no distant differences in clearance rates were noted. Results for thirty-nine 5- to 8-year old children with impaired articulation and forty normal age-matched children showed the former group to have delayed chewing times and clearance rates, and poorer oral stereognosis and tongue protrusion control. Although these tests have shown significant differences between relatively large groups, the value of such tests on individuals is limited.

Chewing; Swallowing; Speech articulation; Tongue skills

Ellis, Randy K.; Berg, Joel H.; Raj, P. Prithvi: Subjective signs of efficacious inferior alveolar nerve block in children. J Dent Child, 57:361-365, September-October, 1990.

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ABSTRACTS

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This study is designed to examine the clinical signs relating to profound anesthesia of the primary dentition using the inferior alveolar nerve block (IANB) injection. The IANB injection has been used for many years for both adults and children to anesthetize the mandibular teeth. Most dentists are quite familiar with the signs of profound intraoral anesthesia in the adult. Because of infrequent exposure, they might not be as aware of the signs of adequate anesthesia on the child patient. Additionally, the dentist may not be able to differentiate apprehensive behavior from behavior elicited with inadequate pulpal anesthesia. The study consisted of forty male and female children. The subjects who ranged in age from 3 years to 12 years, with a mean age of 7 years, were scheduled for routine restorative care of mandibular primary teeth. Each subject was injected with 1.8 ml of 2 percent xylocaine, 1:100,000 epinephrine using the mandibular-block technique. Anesthesia was evaluated using direct ice placement, lip reaction, tongue reaction and gingival reaction at intervals of 0, 1, 2, and 5 minutes. The results showed a correlation of lip and tongue anesthesia and pulpal anesthesia over time. A stronger correlation existed with gingival anesthesia and pulpal anesthesia over time. There was no statistical relationship between the subject response to ice and pulpal anesthesia.

Anesthesia, local; Xylocaine; Clinical signs; Facial innervation; Nerve block, inferior alveolar; Pediatric dentistry

Saravia, Mario E.; Svirsky, John A.; Friedman, Richard: Chlorhexidine as an oral hygiene adjunct for cyclosporine-induced gingival hyperplasia. J Dent Child, 57:366-370, September-October, 1990.

Recent advances in surgical technique and chemotherapeutic procedures have greatly increased the survival rates of organ transplantation patients. Of dental importance is the widespread use of the immunosuppressive agent cyclosporine in this special-patient population, a drug that has the potential to cause severe gingival hyperplasia as a side effect. A case is presented illustrating the use of the plaque-inhibitor chlorhexidine as a therapeutic adjunct in possibly arresting this gingival condition.

Hyperplasia, iatrogenic; Occlusion; Organ transplantation; Chlorhexidine; Cyclosporine; Plaque, dental

Fuks, Anna B.; Bimstein, Enrique; Guelmann, Marcio; Klein, Hortense: Assessment of a 2 percent buffered glutaraldehyde solution in pulpotomized primary teeth of schoolchildren. J Dent Child, 57:371-375, September-October, 1990.

This investigation was undertaken, clinically and radiographically, to assess the effect of glutaraldehyde as a pulp medicament in pulpotomized cariously exposed primary molars. Fifty-three primary molars of thirty-two second-grade children were evaluated after being treated by pulpotomy utilizing a 2 percent buffered glutaraldehyde solution. Failures were observed in 5.7 percent of the teeth at the six-month evaluation and increased with time: 9.6 percent after 12 months; and 18 percent after 25 months. Internal resorption was observed in six teeth; external resorption was found in only one tooth. Pulp canal obliteration, which was not listed as a failure, was observed in one tooth after 6 months, yielding a total of twenty teeth at the final examination. In thirty-eight pulpotomized teeth (82.6 percent), the resorption rate was similar to their antimeres; in another seven, root resorption was faster; and only one pulpotomized tooth resorbed more slowly than its antimere. The relatively high failure rate in the present study does not justify recommending a 2 percent buffered glutaraldehyde solution as a substitute to formocresol.

Glutaraldehyde; Pulpotomy; Medicaments; Formocresol

Waldman, H. Barry: Are minority children getting their fair share of dental services? J Dent Child, 57:380-384, September-October, 1990.

A review is provided of available national survey data on oral health of minority and nonminority children, and their use of dental services. Minority children continued to have greater need of dental care but use fewer dental health services, measured by a variety of methods, including the frequency and number of visits, and the types of services provided, such as preventive or restorative services. A smaller percentage of minority children had dental insurance coverage. Findings must continually be presented to legislators and finding agencies.

Demography; Dental services, need [and] demand for; Prevention; Family economics; Dental insurance; Minority groups

Waldman, H. Barry and Shakun, Mortimer L.: Selecting a location for the practice of pediatric dentistry. J Dent Child, 57:385-389, September-October, 1990.

A series of state-by-state correlation procedures was carried out, involving pediatric dentist-to-population ratios and a number of economic and social variables. This was the first step in developing an understanding of the decision process carried out by pediatric dentists as they select practice locations. Suggestions are offered for further directions to be taken.

Dental practice, pediatric; Location; Demography