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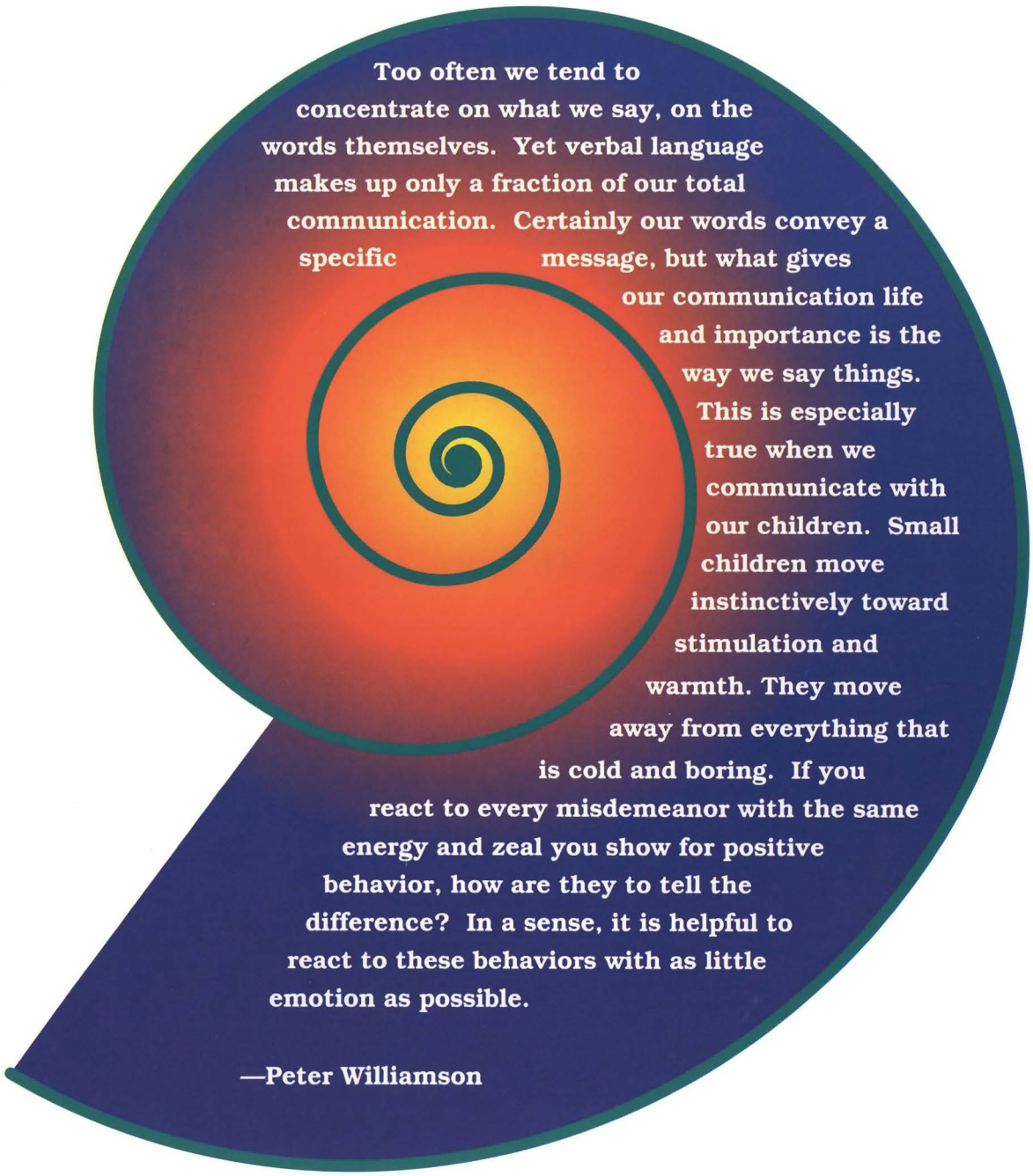
AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

JOURNAL OF DENTISTRY FOR CHILDREN

MARCH—APRIL 1997



THE GREAT SOURCE OF TERROR
IN INFANCY IS SOLITUDE.
—*William James*

Handicaps • STEREOTYPE • Sexism
Children in Crisis

ASDC

AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

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The dark purple represents the coldness and boring from which children instinctively move away; and the decreasing spiral and orange color represent a source of stimulation and warmth toward which they are drawn.
Art and design by Sharlene Nowak-Stellmach

BEHAVIOR

INFANT CARIES

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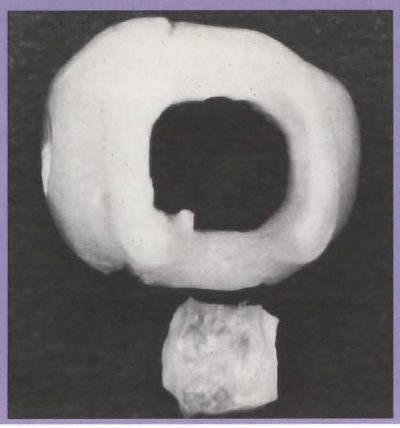

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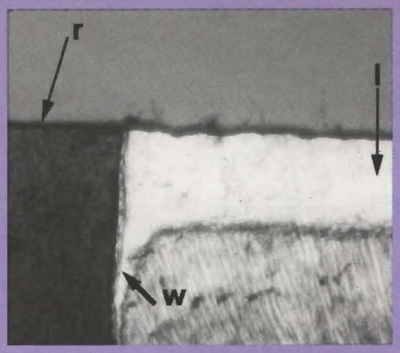

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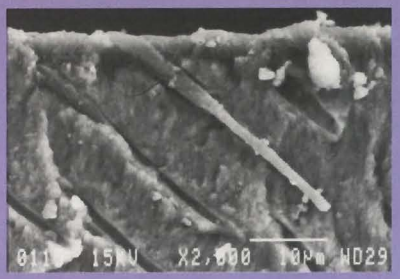

CLINIC

DEMOGRAPHICS

Calendar

1997

ASDC Seminar, ADA, Chicago, IL, May 10.
AAPD Meeting, Philadelphia, PA, May 22-27
ASDC Annual Meeting, Registry Resort, Naples, FL, October 22-26.

1998

ASDC Annual Meeting, Hyatt Regency Beaver Creek, Avon, CO, October 14-18.

BEHAVIOR

Intranasal administration of midazolam: Pharmacokinetic and pharmacodynamic properties and sedative potential

Osamu Fukuta, DDS, PhD
Raymond L. Braham, BDS, LDSRCS, MScD
Hiroshi Yanase, DDS, PhD
Kazuo Kurosu,* DDS, PhD

Recent reports have suggested that the nasal route is preferred for the administration of preanesthetic sedatives to infants and young children.[1-3] Reasons cited are that

- ☐ Nasal administration is probably less upsetting psychologically than intramuscular or intravenous injection;
- ☐ Nasal administration of sedative medication has the advantage of rapid absorption of the drug directly into the systemic circulation from an area rich in blood supply without having to pass through the portal circulation;
- ☐ Agents with rapid hepatic clearance, such as midazolam, present a much higher systemic availability following nasal rather than oral administration.[1-4]

Recent studies have reported favorably that intranasal sedation using midazolam is highly effective when providing dental care for uncooperative mentally disabled patients.[5,6] Subsequent reports have evaluated this technique for the sedation of pediatric dental patients in general.[7,8] Fukuta *et al* and Fuks *et al* found no significant differences between the clinical effects of 0.2 mg/kg and 0.3 mg/kg doses intranasal midazolam during dental treatment.[6,7]

A review of the literature found no reports correlating the sedative effects of intranasally administered midazolam with circulatory and respiratory function. Plasma concentrations of midazolam have been studied during general anesthesia.[9,10] It has been suggested that the greater plasma concentration observed using general anesthesia following preoperative nasal administration of midazolam may be due to the irritant effect of midazolam.[10] No reports, however, have documented plasma concentration of midazolam in conscious patients following intranasal administration of midazolam.

Accordingly, this study was performed on nonanesthetized volunteers.

The objectives of this study were:

- ☐ To determine plasma concentrations at measured intervals following intranasal administration of 0.2 mg/kg and 0.3 mg/kg doses of midazolam.
- ☐ To determine that these concentrations had reached the sedative level.
- ☐ To ascertain the most appropriate sedation period for dental treatment.
- ☐ To relate the variations of the purely sedative effect to changes in the vital signs.

All measurements were made in the resting period without dental stimulus.

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Dr. Braham, Clinical Professor and Associate Chair - Clinical Affairs Division of Pediatric Dentistry, Department of Growth and Development, School of Dentistry, University of California, San Francisco, CA.
*Deceased

A secondary purpose of the study was to determine which of the two doses appeared to be most appropriate for conscious sedation.

A major consideration in designing the study was the fact that it was not ethically feasible to conduct the investigation on nonsedated children. Accordingly, the study was conducted on adult volunteers.

METHODS AND MATERIALS

The subjects were fifteen healthy adult volunteers, ranging in age from nineteen to twenty-five years who were students of Aichi-Gakuin University.

The protocol was approved by the Institutional Review Board and Informed Consent was obtained from all subjects before undertaking any procedures.

Each subject underwent a comprehensive physical examination, not more than forty-eight hours before the procedure. Any report of an upper respiratory or ear infection within the ten days preceding the physical examination resulted in exclusion from the study. Only those subjects with ASA physical status I or II were deemed eligible for the study. All subjects were kept without solid foods for a minimum of six hours prior to sedation and only clear liquids were permitted up to four hours before sedation. All procedures were scheduled for early morning appointments.

Eligible subjects were randomly assigned in a doubleblind manner to two groups, receiving either 0.2 mg/kg or 0.3 mg/kg midazolam administered intranasally.

Each subject was settled in the dental chair in a recumbent position. Monitors were affixed and venipuncture needles for collection of blood samples were placed. After a rest period of 15-20 minutes, each subject received two divided doses of either concentration of midazolam in doubleblind manner, as previously described. Use of the intranasal route of administration necessitated that the total volume of liquid instilled be reduced to a minimum. Accordingly, the midazolam was prepared in the Aichi-Gakuin University Pharmacy to a concentration of 0.025 ml/mg (40 mg/ml). Using a 1 ml tuberculin syringe without a needle, half the midazolam was instilled rapidly into one nostril and the remainder into the other nostril.

Table 1 depicts the rating scale for evaluation of sedative effects and classification of sedation stages. The subjects' behavior was evaluated at fixed intervals using a behavior rating scale of 1-8. Readings were taken at five-minute intervals from the rest period through sixty minutes postadministration, every ten minutes through ninety minutes and every thirty minutes through 150 minutes. The behavior during the rest period was designated as the control behavior.

Table 1 ☐ Rating scale for evaluation of sedative effect.

Sedation scores	Behavior and signs	Classification
1	Sleeping. No response to patting the shoulder.	Asleep
2	Sleeping. No response to calling by name two or three times. Responds to patting on the shoulder.	
3	Eyes closed, dull reaction. Responds to verbal stimulus as above.	Drowsy
4	Eyes open and closed by turns, dull reaction Responds to verbal stimulus	Sedated
5	Eyes open, dull reaction. Responds to verbal stimulus	
6	Normal reaction.	Normal
7	Irritable with body movement.	Excited
8	Highly irritable with considerable body movement.	

Table 2 ☐ Plasma concentration of midazolam. (ng/mg)

	After intranasal midazolam instillation (min.)						
	5	10	20	30	60	90	120
0.2 mg/kg group							
Case No. 1	114	108	150	96	89	71	47
Case No. 2	5	131	190	120	99	93	66
Case No. 3	31	166	131	115	91	78	69
Average	50.0	135.0	157.0	110.3	93.0	80.7	60.7
S.D.	46.5	23.8	24.6	10.3	4.3	9.2	9.7
0.3 mg/kg group							
Case No. 11	27	52	133	118	87	81	74
Case No. 12	27	262	361	297	185	170	147
Case No. 13	49	219	279	240	150	164	114
Average	34.3	177.7	257.7	218.3	140.7	138.3	111.7
S.D.	10.4	90.6	94.3	74.7	40.5	40.6	29.8

Plasma concentrations of midazolam were analyzed using venous blood samples from each of three randomly selected subjects for each of the two doses. Venous blood samples were obtained at five, ten, twenty, thirty, sixty, ninety, and 120 minutes postadministration of midazolam.

Vital signs, monitored continuously and recorded at five-minute intervals, included electrocardiogram, heart rate, blood pressure, respiratory rate and oxygen saturation (SPO_2). The value of the rest period at five minutes preadministration was used as the control value in all indicators.

Postoperatively, all subjects were admitted to the recovery-room where their vital signs and bodily functions were closely monitored over a period of sixty minutes. Specific attention was paid to standing and walking, talking, and any adverse effects such as nausea and/or dizziness.

The following morning each subject and/or the roommate was interviewed as to adverse effects following discharge.

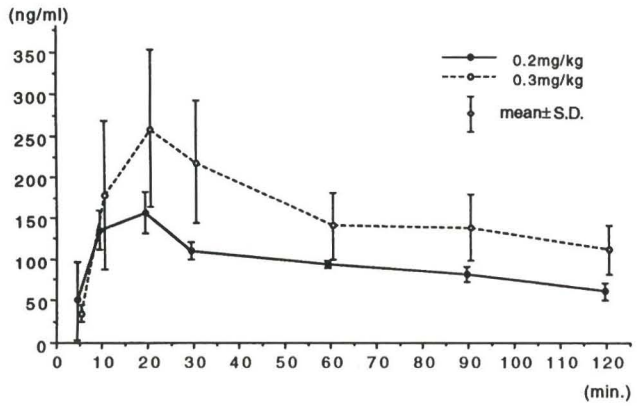

Figure 1. Plasma concentration of midazolam after intranasal instillation.

Statistical analyses

Results were analyzed using the Mann-Whitney U-test, Wilcoxon's t-test, Student's t-test and Paired t-test. The level of significance was set at 0.05.

RESULTS

Plasma concentration of intranasal midazolam

These are shown in Table 2 and Figure 1. The mean peak plasma concentration of midazolam in the 0.2 mg/kg group was 157.0 ± 24.6 ng/ml at twenty minutes postadministration, decreasing to 60.7 ± 9.7 ng/ml 120 minutes postadministration. The mean peak plasma concentration of midazolam for 0.3 mg/kg group was 257.7 ± 94.3 ng/ml at twenty minutes postadministration, decreasing to 111.7 ± 29.8 ng/ml 120 minutes postadministration. The mean standard deviation for the 0.3 mg/kg dose was wider than that of the 0.2 mg/kg dose.

Sedative effects (Table 3, Figure 2)

When the intranasal midazolam was instilled, five subjects out of eight in the 0.2 mg/kg and all subjects in the 0.3 mg/kg group reported discomfort and/or pain within the nasal passages and/or throat. The initial sedative effect for both groups was seen within five to ten minutes postadministration. Approximate maximal sedative effects were attained from twenty to twenty-five minutes postadministration. These continued, in both groups, until fifty-five to sixty minutes postadministration. Comparison of distribution of sedative scores between control and postadministration midazolam using Wilcoxson's test, revealed significant differences from ten minutes through seventy minutes postadministration for the 0.2 mg/kg group. Similarly, there were significant differences from fifteen minutes through seventy minutes postadministration in the 0.3 mg/kg group. There were no significant differences, in any phase of this study, between the sedative effects of either group when the Mann-Whitney test was applied.

One hundred and fifty minutes postadministration, two subjects from the 0.3 mg/kg group experienced

Table 3 ☐ Distribution of sedation scores after intranasal midazolam administration (Number of subjects)

	Sedation score	Control	Admin.	5	10	15	20	25	30	35	40	45	50	55	60	70	80	90	120	150
0.2 mg/kg group	1								1	1	1	3								
	2						2	3	2	2	2	1	4	3	2					
	3					1		1	1	2	1			2	1	1	1			
	4				1	1	5	4	4	2	3	3	3	1	2	2	2	3	2	
	5				4	4	1			1				1	1	1			1	1
	6	8	3	7	3	2					1	1	1	1	2	4	5	5	5	7
	7		5	1																
	8																			
	Control vs. Post-administration				**	**	**	**	**	**	**	**	**	**	**	*				
0.3 mg/kg group	1										1		1	1						
	2							2	2	3	3	4	3	3	1	1				
	3					1	1	2	2	2	1	2	2							
	4					3	5	3	3	1	1			2	5	3	2	1	1	
	5				3	2	1			1	1	1				1	1	2	1	1
	6	7	0	6	3	1								1	1	2	4	4	5	6
	7		7	1	1															
	8																			
	Control vs. Post-administration					**	**	**	**	**	**	**	**	**	**	*				

Comparison of distribution of sedation scores between control and post-administration using Wilcoxon's test (*$p<0.05$, **$p<0.01$). There was no statistical difference at any stage between the sedative effects of either group using Mann-Whitney test ($p>0.05$).

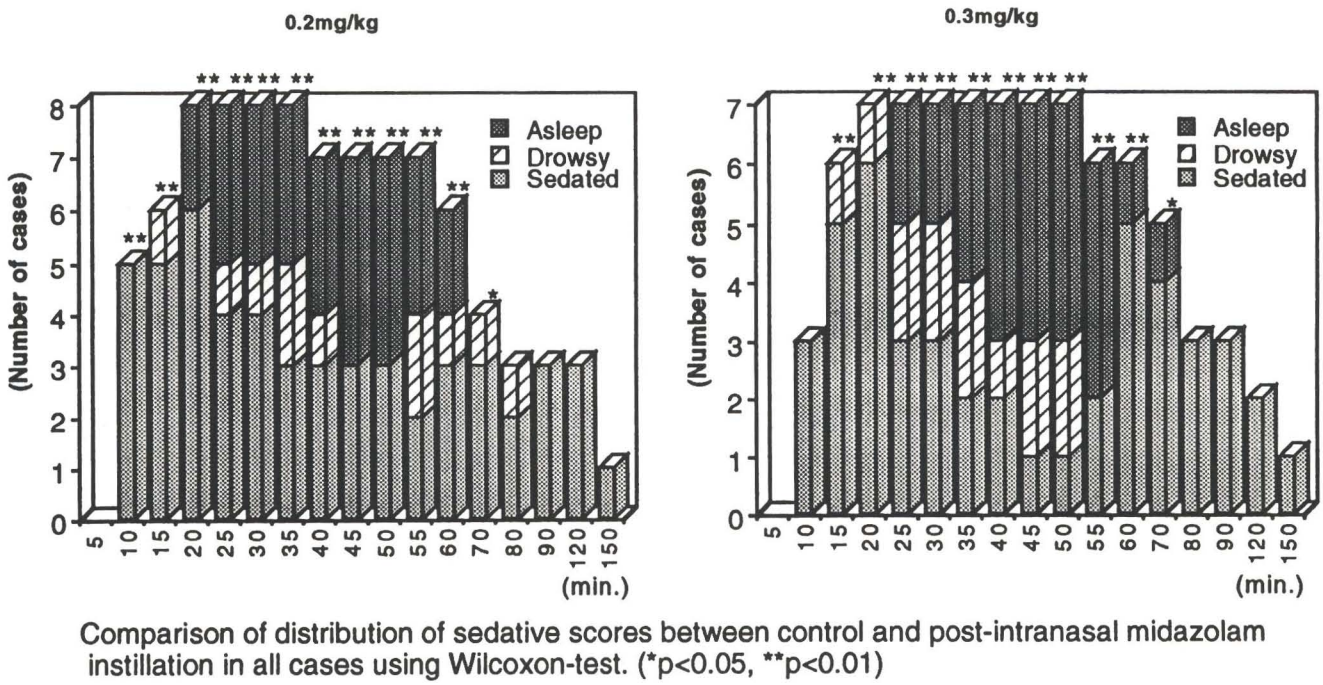

Figure 2. Changes in sedative effects after intranasal instillation of midazolam.

slight dizziness or disorientation. None of 0.2 mg/kg group, however, showed any signs of dizziness or disorientation. One hundred and eighty minutes postadministration, no subjects exhibited somnolence, dizziness or disorientation. In both groups, all subjects had recovered normal bodily functions and conversational ability within 150-180 minutes of the initial drug administration.

Vital signs (Table 4)

Systolic blood pressure, diastolic blood pressure and heart rate tended to increase for ten to twenty minutes postadministration. Subsequently, they tended to decrease to the same or lower levels than the control levels. All variations were determined to be within normal limits, with no adverse effects being observed throughout the study period. There was no significant difference at any stage between either group when the Student's t-test was applied (Figures 3 and 4).

The respiratory rate for both groups showed a slight increase compared with the control level. No significant difference between either group was noticed at any stage, using the Student's t-test. One subject in the 0.3 mg/kg group, however, did register an increase in respiratory rate of six breaths/minute (Figure 5).

When compared with the control levels, the SpO_2 for both groups tended to decrease for fifty-five minutes postadministration. Using the Paired t-test, the levels at some stages showed a significant decrease compared with the control level. Using the Student's t-test, (Figure 6), revealed no significant difference between either group at any stage. One subject in the 0.3 mg/kg group, however, did exhibit a decrease in oxygen saturation to 88 percent, while one of the 0.2 mg/kg group dropped to 91 percent. In each case, normal SpO_2 levels were immediately restored, utilizing the jaw-lift (Figure 7).

No adverse effects were reported for the poststudy period through to the following morning.

DISCUSSION

In most cases, those dental patients requiring intranasal sedation, using midazolam, will be the very young or those with mental disabilities. In this study, the data were obtained, using volunteer adults because of the difficulty in justifying to the parents of children, the procedures required to measure plasma concentration and record the vital signs without performing an accompanying dental procedure.

Table 4 ☐ Changes of vital signs

		Control	Administration	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	60min	70min	80min	90min	120min	150min
Systolic blood pressure	0.2mg/kg mean	119.5	128.9	130.3	125.1	119.6	119.3	118.6	115.0	117.0	112.3	107.4	109.9	111.5	111.0	112.9	110.6	112.3	110.6	114.6
	S.D.	10.7	15.7	14.8	13.4	9.7	11.9	8.7	10.8	10.0	10.7	10.3	12.8	9.8	9.7	9.6	7.5	6.0	9.2	8.1
	Control V.S. Post-admin.		*	**	*						*	**	*	**	**		*	*	*	
	0.3mg/kg mean	112.0	128.7	128.4	123.3	117.1	115.6	120.0	113.4	112.1	109.1	110.6	108.7	107.3	111.4	112.0	109.9	107.9	105.6	110.0
	S.D.	6.0	7.2	9.6	11.2	9.7	8.2	10.7	7.0	5.2	6.5	8.3	6.6	5.3	7.8	7.6	5.8	6.6	5.9	6.7
	Control V.S. Post-admin.		**	**	*														**	
Diastolic blood pressure	0.2mg/kg mean	66.5	68.6	73.8	71.0	66.1	67.0	62.9	61.0	61.1	59.5	57.4	57.8	59.8	59.8	62.5	59.5	59.6	58.3	62.3
	S.D.	7.7	13.9	9.2	7.4	6.1	8.2	6.9	5.5	5.9	7.0	5.3	5.6	5.7	5.7	5.7	6.8	6.2	6.2	6.8
	Control V.S. Post-admin.			*	*			**	*	*	**	*	**	**	*			*	*	
	0.3mg/kg mean	61.4	75.4	76.4	72.3	70.4	65.3	64.7	63.3	61.9	60.0	60.1	59.7	59.7	58.4	61.3	60.3	59.9	58.3	61.0
	S.D.	5.3	4.2	4.8	8.9	10.5	4.0	6.5	4.2	5.4	3.4	4.2	4.7	4.6	4.3	7.5	5.0	4.6	6.2	3.3
	Control V.S. Post-admin.		**	**	*	*													*	
Heart rate	0.2mg/kg mean	69.3	79.9	78.4	78.4	76.6	67.9	69.5	70.4	69.0	65.3	65.5	65.5	64.4	63.5	64.8	66.0	64.8	59.6	61.3
	S.D.	8.3	10.1	9.7	9.9	6.1	7.4	4.5	4.0	6.0	7.3	6.9	6.8	6.0	7.8	9.5	5.6	5.4	6.7	6.6
	Control V.S. Post-admin.		**	*	**	*								*	*			*	*	**
	0.3mg/kg mean	69.9	81.0	80.0	82.9	81.1	78.0	74.9	76.7	74.9	73.6	74.3	69.6	98.9	68.1	68.6	66.4	62.7	62.1	66.9
	S.D.	9.2	12.8	11.8	13.1	13.8	12.9	12.4	15.7	13.1	13.1	11.4	10.4	10.0	14.1	10.2	11.2	7.3	10.8	12.5
	Control V.S. Post-admin.		**	**	**	**	*											**	*	
SpO_2	0.2mg/kg mean	98.1	98.1	97.9	96.9	96.4	97.3	97.1	96.8	97.3	96.8	96.6	96.5	97.3	97.8	98.0	97.4	98.0	98.3	97.9
	S.D.	0.6	0.6	0.8	0.9	1.6	1.1	1.1	0.4	0.7	0.4	1.6	2.1	0.7	0.7	0.5	1.3	0.7	0.4	0.6
	Control V.S. Post-admin.			*	*				**	*	**			*						
	0.3mg/kg mean	97.6	97.9	97.4	97.1	96.0	97.0	96.7	96.9	97.4	96.9	96.3	96.3	95.4	97.6	97.3	97.7	97.3	97.6	98.0
	S.D.	0.7	0.8	1.4	0.6	0.9	0.7	1.3	1.1	0.7	0.8	1.4	2.4	3.1	0.7	1.0	0.9	1.2	0.7	1.1
	Control V.S. Post-admin.					*														
Respiratory rate	0.2mg/kg mean	15.0	15.6	15.4	15.1	15.5	16.1	16.1	15.8	15.5	15.0	15.6	16.4	15.6	16.3	16.6	16.8	18.1	17.8	16.0
	S.D.	2.5	3.8	3.7	3.3	2.5	3.4	2.6	2.9	3.0	2.4	2.4	1.8	2.3	1.9	1.6	1.9	2.1	2.4	2.5
	Control V.S. Post-admin.															*		**	*	
	0.3mg/kg mean	14.9	17.3	14.7	14.9	14.7	16.0	15.9	15.3	15.6	16.7	17.1	17.7	17.1	16.1	17.9	15.2	16.7	17.2	16.6
	S.D.	2.4	4.7	3.8	2.4	4.1	3.5	4.3	4.0	2.1	2.5	1.1	3.5	1.6	4.5	1.2	1.7	2.1	0.7	2.1
	Control V.S. Post-admin.												*	*		*		*	*	*

Comparison of all changes between the control and the post-administration midazolam using Student's t-test (*$p<0.05$, **$p<0.01$). There was no statistical differences in any phase of all items between both groups using Mann-Whitney test ($p>0.05$).

Walbergh *et al* reported that 0.1 mg/kg intranasal midazolam achieved a peak plasma concentration of 72.2 ng/ml in 10.2 min.[9] They reported, furthermore, that the concentration of intranasal midazolam was only 57 percent of 0.1 mg/kg midazolam when administered intravenously. Malinovsky *et al* reported that for intranasal midazolam of 0.2 mg/kg, C_{max} was 182 ng/ml within 12.6 minutes and that for rectal midazolam of 0.2 mg/kg, was 48 ng/ml within 12.1 minutes.[10] They stated further that the concentration curves of intravenous midazolam, 0.2 mg/kg, and nasal midazolam, 0.2 mg/kg, forty-five minutes postadministration were similar.

We found the peak plasma concentration of 0.2 mg/kg midazolam in the present study (157.0 ng/ml) to be slightly lower than that of Malinovsky *et al* (182ng/ml).[10] Crevoisier *et al* reported, however, that the individual threshold plasma concentration of midazolam for sedation varies the range 30-100 ng/ml.[11] Allonen *et al* reported that the hypnotic action of midazolam was visible at a concentration above 80 ng/ml and that the subjects often fell asleep for some minutes when the concentration exceeded 100 ng/ml.[12]

Persson *et al* reported that the average plasma concentration of midazolam in conscious patients was 68 ng/ml.[17] In the present study, midazolam dosages of 0.2 mg/kg resulted in plasma concentrations up to 135 ng/ml, while 0.3 mg/kg dosages attained 177 ng/kg plasma concentrations within ten minutes. In this study, the doses were sufficient to achieve sedative levels.

With the 0.3 mg/kg dose, the standard deviation was wider than that of the 0.2 mg/kg dose, indicating that plasma concentrations of 0.3 mg/kg had a large individual variation compared with that of 0.2 mg/kg. In the 0.3 mg/kg dose group, two cases demonstrated higher and lower plasma concentrations than those of the 0.2 mg/kg group. As a result, comparison of the two doses

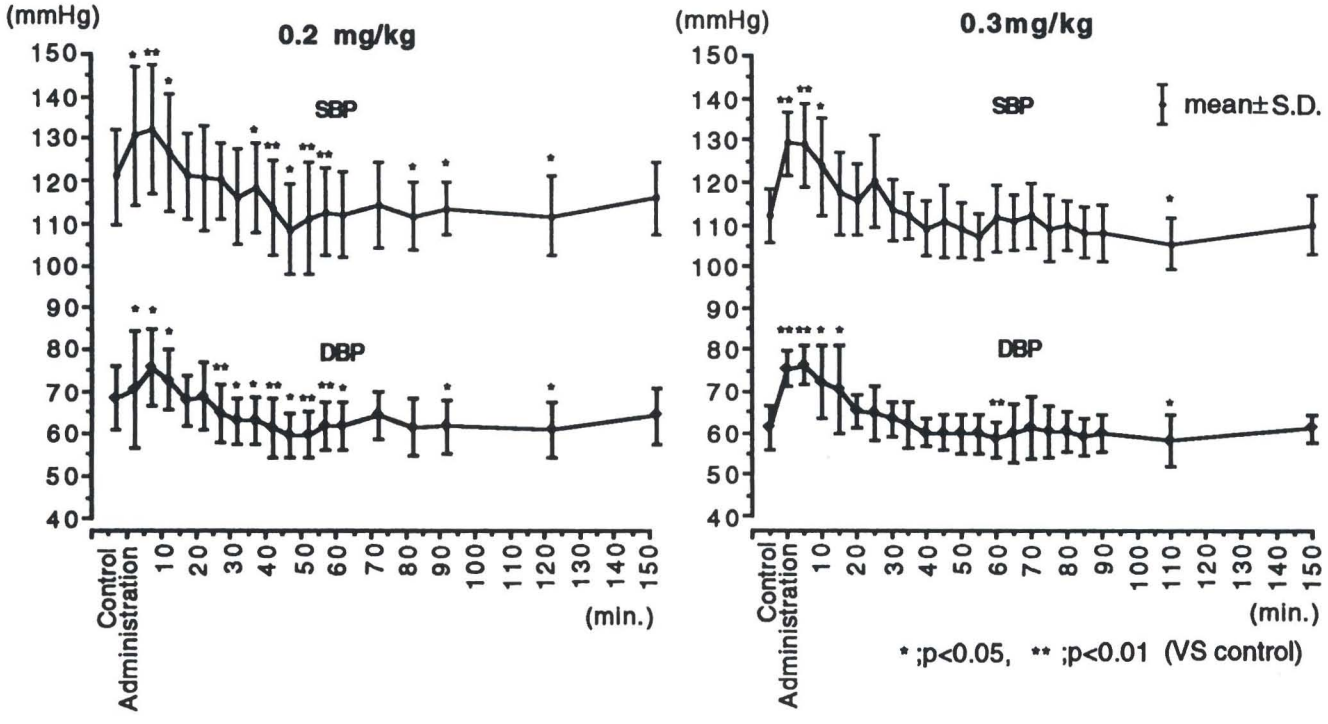

Figure 3. Changes in systolic blood pressure (SBP) and diastolic blood pressure (DBP).

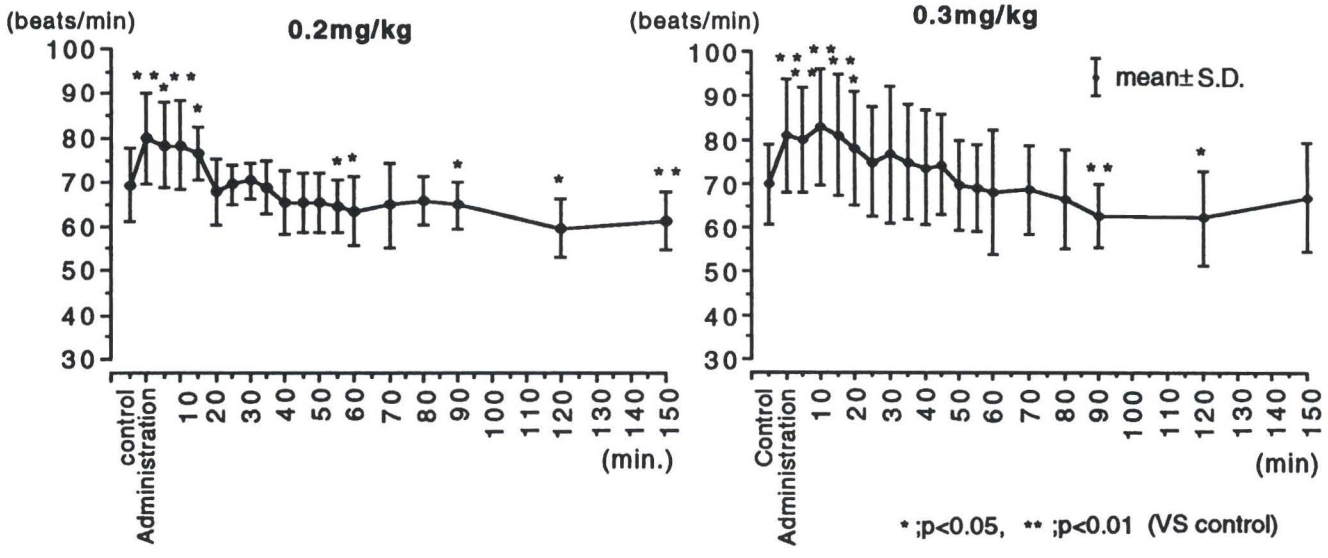

Figure 4. Changes in heart rate (HR).

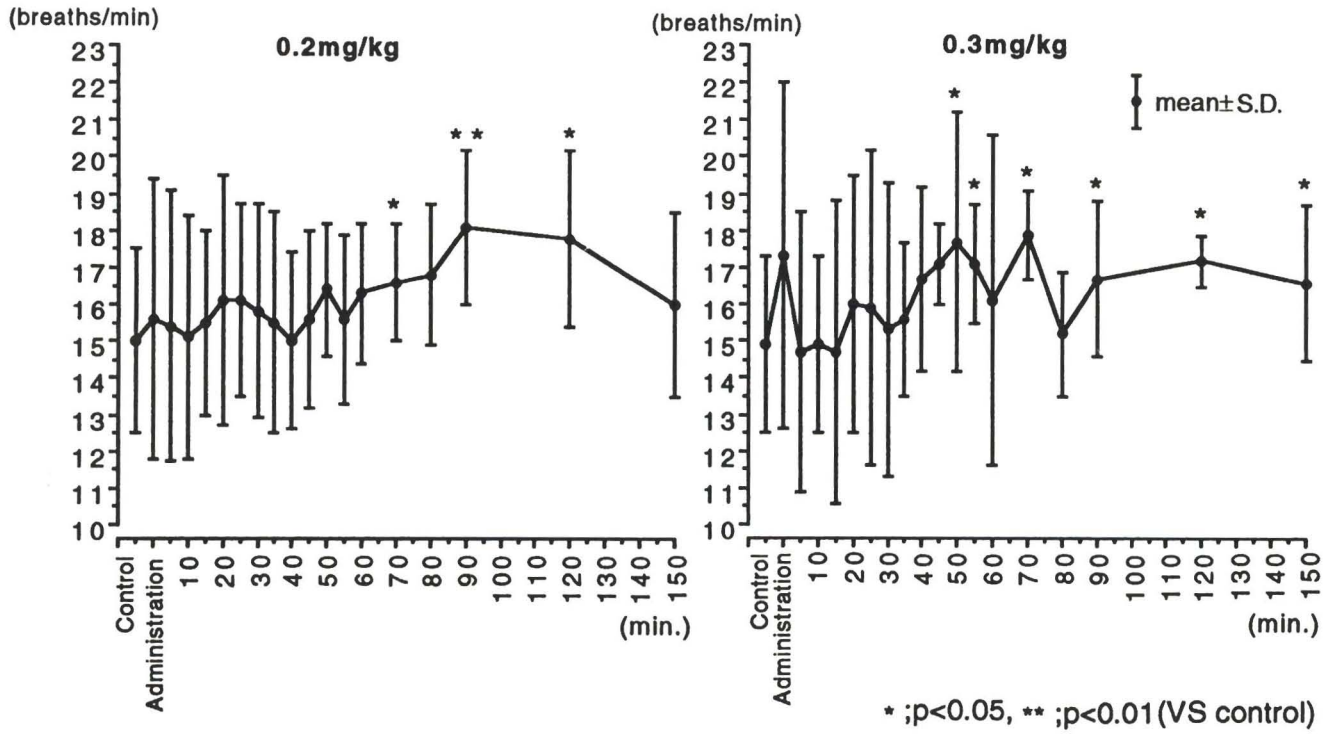

Figure 5. Changes in respiratory rate (RR).

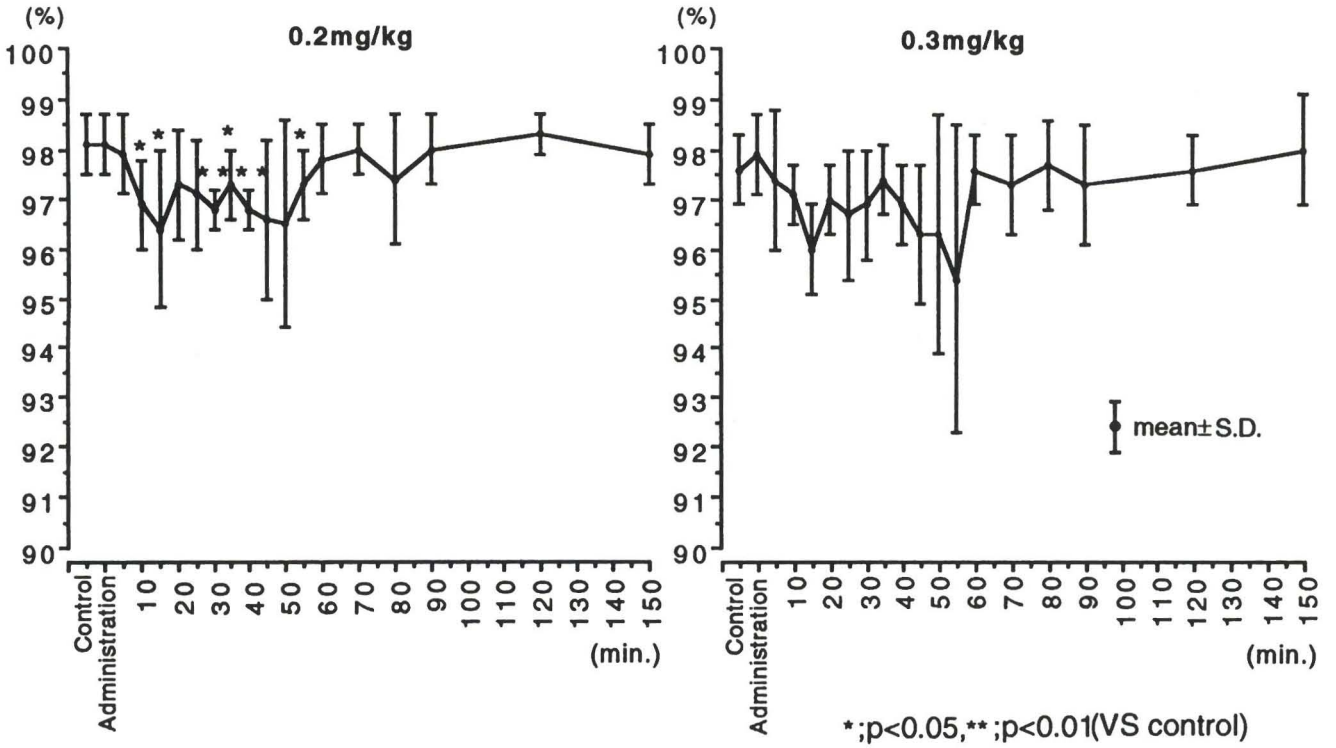

Figure 6. Changes in O_2 saturation (SpO_2).

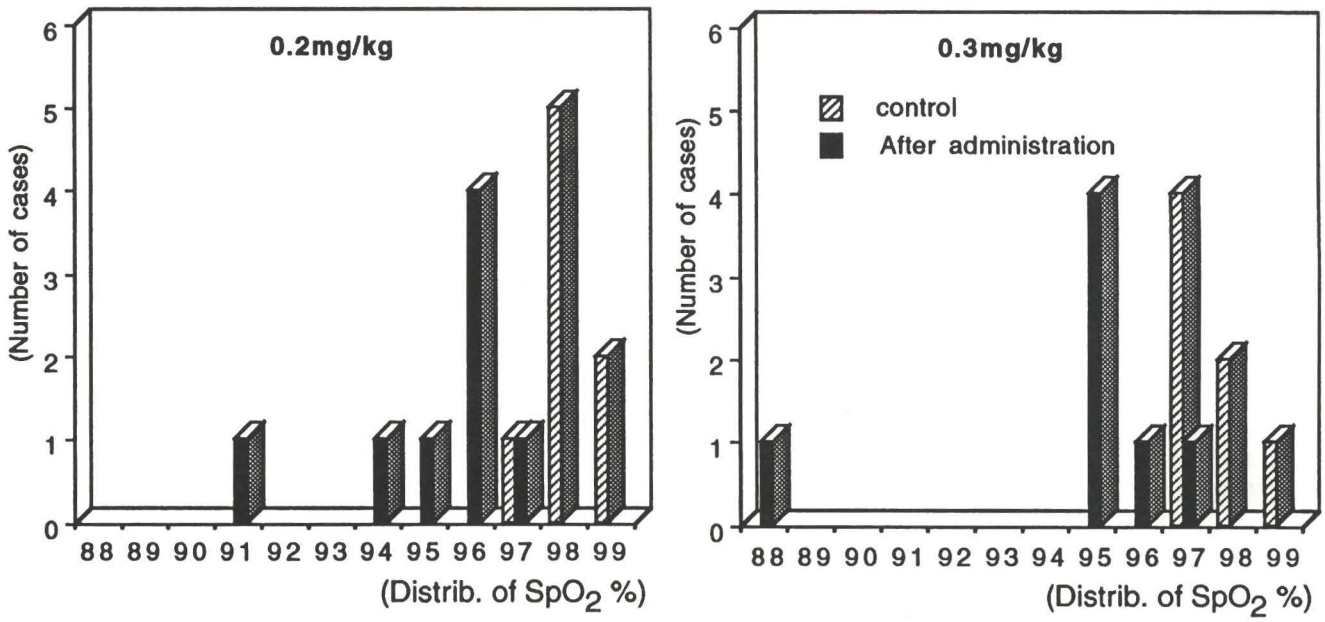

Figure 7. Distribution of SpO_2 of the control and lowest value in all cases.

may not demonstrate significant differences in regard to sedative effects. In this context, several authors have reported that the clinical effects of intranasal midazolam 0.2 mg/kg and 0.3 mg/kg were similar.[2,5,7] Wilton *et al* concluded that 0.3 mg/kg dose necessitated a larger volume, possibly resulting in more coughing and sneezing with expulsion of part of the dose. The present study supported the opinion of Wilton *et al*.[2]

With regard to sedative effects, all subjects in both dosage groups demonstrated satisfactory sedation status from fifteen to twenty minutes until fifty-five to sixty minutes postadministration. We believe this to be a perfectly suitable period to carry out dental treatment. In both groups, all subjects recovered normal bodily and speaking function within 150-180 minutes post-drug administration. It is postulated, therefore, that the recovery time is 150-180 minutes after administration. In a previous report we determined the recovery time to be 129.3 minutes for the 0.2 mg/kg dose and 131.8 minutes for the 0.3 mg/kg dose.[6] It is our belief that these differences in recovery time between the two studies resulted from differing investigational environments.

The subjects' sedation levels in this study were evaluated under ideal circumstances with no adverse stimuli. In the actual clinical situation, patients will be subjected to various stimuli during dental treatment and the sedation level may be lighter in comparison to our data. For this reason, we are of the opinion that intranasal midazolam should be supplemented with nitrous oxide/oxygen inhalation sedation, in order to achieve more effective sedation levels in carrying out pediatric dental treatment. By using nitrous oxide/oxygen sedation, the dentist is able to adjust the patient's sedation level to the prevailing conditions.

In this study, systolic blood pressure, diastolic blood pressure, and heart rate tended to increase for ten to twenty minutes postadministration after which there was a tendency to decrease to the same or lower levels than controls. It may be postulated that the initial tendency to increase is a result of the stress and/or pain of nasal administration. In this regard, Karl *et al* commented that this was a complication of this technique, since 61 percent to 74 percent of pediatric patients cry with nasal administration of drugs.[13] Indeed, twelve out of fifteen subjects in this study complained of discomfort or pain in the nose or throat and there was a corresponding increase in blood pressure and heart rate. The technique of nasal administration of midazolam was developed and recommended as being less painful and traumatic than intramuscular or intravenous injection. The results of this study suggest that the stimulus of nasal midazolam instillation may be unexpectedly strong. Further studies on alleviation of stress at the time of administration of a nasal drug are indicated.

It is also possible that increases in blood pressure and heart rate may be a result of the subjects being relaxed by the sedative effects of midazolam. Ann *et al* reported similar results with intravenous midazolam sedation.[14] The changes resulting from a 0.2 mg/kg dose actually appeared slightly larger than those of 0.3 mg/kg dose. We feel that this apparent paradox of dose-reaction activity may be the result of a large individual difference of plasma concentration of midazolam in the 0.3 mg/kg dose.

A further consideration could be that the increases in blood pressure were actually related to the discomfort or pain within the nasal passages or throat reported by the majority of the subjects, when the intranasal midazolam was instilled. In other words, the blood pressure increased simply because the patients disliked the procedure.

Kondo *et al* reported that the respiration rate increased slightly with an intravenous sedation dose of 0.075 mg/kg midazolam.[15] Respiratory depression necessitating jaw-lift, however, did not occur. On the other hand, Noguchi *et al* suggested intravenous sedation of 0.070 mg/kg midazolam resulted in respiratory depression, as demonstrated by a significant decrease in SpO_2 for some sixty minutes postadministration.[16]

The present data corroborate Noguchi's results on SpO^2.[16] In both dosage groups, intranasal midazolam resulted in respiratory depression. In each instance normal levels were immediately restored by the jaw-lift maneuver. We do not believe the respiratory depression associated with a 0.2 mg/kg dose to be a serious adverse effect. It may be the result of muscular relaxation in the tongue and/or airway due to the sedative effects of midazolam. One case in the 0.3 mg/kg group did result, however, in an 88 percent oxygen desaturation with an accompanying increase of six breaths/minute in respiratory rate. We feel that the respiratory depression in this case was severe. There can be no denying the possibility of central respiratory depression with a 0.3 mg/kg dose. On occasion a dose of 0.3 mg/kg midazolam may result in a high plasma concentration and create a risk of severe respiratory depression.

The results of this study suggest that both intranasal doses of midazolam are effective. No benefit was observed using the higher dose of 0.3 mg/kg midazolam. We recommend using the lower dose of 0.2 mg/kg intranasal midazolam for safe conscious-sedation.

It should be noted that the terminal elimination half-life (t1/2β) of the intranasal midazolam is not yet known. In general, midazolam has a short terminal elimination half-life (t1/2β). For rectal midazolam it is 106 minutes while that for intravenous administration is 2.5 hours.[18,19] In the present study, the average plasma concentration of 0.2 mg/kg was 60.7 ng/ml with a postadministration range of 47 ng/kg to 69 ng/kg at 120 minutes. These levels were border-line "awake" and "threshold for sedation". We stress that the plasma concentration level may not be exactly below the "awake" level, since the patients did not demonstrate any clinical sedative effects 120 minutes postadministration. In regard to this, it should be noted that a longer investigational period is required.

CONCLUSION

Plasma concentration of midazolam in both groups maintained adequate sedation levels with each dosage group sustaining favorable sedative conditions from fifteen to twenty minutes up to fifty-five to sixty minutes. Individual variations of midazolam plasma concentration within the 0.3 mg/kg dose group were greater than those for the 0.2 mg/kg dose group. Variations in blood pressure and heart rate due to the stress of nasal instillation of midazolam were observed in both dosage groups. None of these changes were considered to be outside normal levels and no adverse effects were noted during the duration of the study. Minor respiratory depression was observed in the 0.2 mg/kg dose group, although no significant clinical difficulties were observed. In the higher dose group there was one instance of severe respiratory depression. It may be concluded that a 0.3 mg/kg intranasal dose of midazolam may involve the risk of producing severe respiratory depression. The results of this study suggest that both intranasal doses of midazolam are effective. No benefit was observed using the higher dose of 0.3 mg/kg midazolam. We recommend using the lower dose of 0.2 mg/kg intranasal midazolam for safe conscious-sedation.

Although this study was performed primarily to observe the effects of two dosages of midazolam, it was done also with the suggestion that once the effectiveness and the safety of the procedure were determined, it might be used to sedate fearful or disruptive children. That study is yet to be conducted.

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DOES FRUCTOSE PRODUCE ANY ADVERSE EFFECTS?

Ingestion of excessive amounts of fructose in a normal individual can lead to lactic acidosis, hyperuricemia, and dental caries. Individuals with hereditary fructose intolerance who avoid all sources of fructose have a notable lack of dental caries.

Berry G.T.: In *Pediatric secrets*. 2nd Ed.
Philadelphia: Hanley and Belfus, Inc.
1997, p 312.

The ethological method as a means for evaluating stress in children two to three years of age during a dental examination

Caroline Rousset
Michel Lambin
François Manas

The ethological method is a reliable instrument for the observation and measurement of the behavior of an individual under nonexperimental conditions. With this method, the subjects are studied in their usual environment and the entire range of their behavior is considered.

Animals served as the first models for ethological study but progressively, the method has been applied to human study.

The first ethological studies of human beings began with the study of the infant, followed by studies of the bonds uniting the child and mother, then to the notion of "attachment"; and, most recently, to the child-father relationship.[1-9]

Until recently the levels of stress experienced by a child patient who was confronting a dental practitioner for the first time could only be measured by a questionnaire presented to the parent accompanying the child.

In the present study, we used an ethological method to analyze the levels of stress experienced by children who were two and a half to three years old at the time of a dental examination. We first studied whether differences of behavior between children depend on their sex and/or on the sex of the accompanying parent; second, we tested the potential relationship between the anxiety levels of the child and that of the parents. The differences observed and quantified between the children, demonstrate the ability of the ethological approach to provide information about the behavior of children and that of their parents in a situation such as a dental examination.

METHOD

☐ *General principles of the ethological method*

Due to the diversity of motor actions made by subjects in a situation, video recordings were made to provide a means of making complete and effective observations. Before statistical analysis was begun, the films were first observed in order to create a comprehensive list of all units of behavior displayed by the subject. The systematic utilization of the list thus created permitted, therefore, the transcription of behaviors observed in subjects into successive coded units, by which we could then follow the temporal distribution of the behaviors and quantify them in terms of their frequencies, their sequential

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connections, or their duration. All video recording and the listing of all units of behavior displayed by the subjects were performed by the same author (C.R.).

☐ *Application to our study*

The subjects in our study were children between the ages of two and a half to three years old, from two nursery schools in Toulouse (France). The dental examination was part of a series of medical examinations (organized by the PMI: Protection Maternelle Infantile). Six or seven days before the examinations were to occur, the parents were advised by a nursery school worker that the dental examination would be filmed. The simultaneous video recording of the child-parent pair began at the moment the child and the accompanying parent entered the examining room and ended at the moment they left the room.

In order to control the length of the observation period and keep the practitioner's behavior constant, the examination was done in two stages: the first part consisting of an oral cavity examination of the child and the second part in which the practitioner presented a questionnaire to the accompanying parent. The goal of the questionnaire was, on one hand, to return the child to a familial context and on the other hand, to standardize the questions posed to the parents. Furthermore, the period of time spent filling out the questionnaire by the practitioner as the parent responded to the questions constituted a time when observations could be made of the behaviors of the child-parent-practitioner triad. The video cassette recordings were made continuously, permitting us to observe the flow of behavior and to have real time information about the rate, duration, and sequential order of the different activities. Forty child-parent pairs, each consisting of a child and the accompanying parent were studied. Since our goal was to study the personal experience of the child in the presence of the dental surgeon, only children who had never had a dental examination before the time of the experiment were used. In all, there were:

Ten girl-mother pairs (G+M), ten boy-mother pairs (B+M), ten girl-father pairs (G+F), ten boy-father pairs (B+F)

☐ *Methods of data analysis, creation of list of behaviors, data processing*

Following the methods of the observer-describer-naturalist, the most neutral observations possible were made of all events recorded on the video tapes, with no gaps in the observations. The total activity of each subject, therefore, was considered. Following the minute observations of all the videotapes, two behavioral lists were created for data analysis: the first was a "child" behavioral list, consisting of 218 separate items (motor activity); the other was a "parent" list, consisting of 117 items. Each film, one per parent-child pair, was analyzed and a file created, which presented the development of the simultaneous actions of the child and the parent. Forty files were thus created, one per child-parent pair. First, the forty files were analyzed by a software system that counts the frequency of occurrence of each behavioral unit performed by the child on one hand and by the parent on the other. Next, all the behavioral lists, both "child" and "parent", were regrouped into categories of functional equivalence.

RESULTS

Categorization of the "child" list of behaviors (with the frequency of occurrences)

ABSENCE OF CONTACT

☐ Oriented displacements (OD) N=167

Combine together all items reflecting a displacement toward an object or around an object, but without contact.

☐ Non-oriented displacements (NOD) N=586

Reflect a displacement lacking orientation, in the examination room, or a whole-body movement leading to a displacement.

☐ Non-oriented movements (NOM) N=250

Movements affecting one or several parts of the body, without contact with an object.

Postures.

☐ Movements of body (PMvB) N=636

Reflect a movement of the body leading to a change in posture.

☐ Positive mimico-vocal (+MV) N=85

Reflect a non-directed, affiliative bearing.

☐ Neutral mimico-vocal (NMV) N=257

☐ Negative mimico-vocal (−MV) N=39

Reflect an attitude of refusal in a given situation.

ACTS DIRECTED TOWARD AN OBJECT

☐ Direct contacts with the object (DCobj) N=442

Manipulations of objects.

☐ Indirect contacts with the objects (ICObj) N=21

All acts directed toward the object, but without direct contact.

☐ Looking toward the object (Obj(Look)) N=2201

ACTS DIRECTED TOWARD "SELF"

☐ Direct auto contacts (DAC) N=323
Acts directed toward child's own body.
☐ Looking toward child's own body. (OB(Look)) N=51

ACTS DIRECTED TOWARD THE PARENT

☐ Direct contacts with the parent (DCPar+) N=398
Reflect proximity to the parent by maintaining direct physical contact.
☐ Distancing from the parent (distPar) N=63
Reflect a loss of physical contact with the parent.
☐ Contacts with the parent through an intermediary object (CPar (obj)) N=70
☐ Looking toward the parent (Par (Look)) N=613
☐ Contacts with the parent by gestures or voice (CPar (g-v)) N=103
☐ Displacements toward the parent (Disp-> Par) N=110

ACTS DIRECTED TOWARD THE PRACTITIONER

☐ Displacements toward the practitioner (Disp-> Prt) N=11
☐ Looking toward the practitioner (Prt (Look)) N=1137
☐ Contacts with the practitioner by voice or gestures (CPrt (m−v)) N=154
☐ Contacts with the practitioner through an intermediary object (Cprt (obj)) N=3
☐ Affiliative attitudes directed toward the practitioner (Cprt+) N=37
☐ Negative attitudes directed toward the practitioner (Cprt−) N=51

Categorization of the "parent" list of behaviors (with the frequency of occurrences)

ABSENCE OF CONTACTS

☐ Displacements (Disp) N=189
☐ Body movements (BMv) N=504
Comparable to NOM and PMvB in the child.
☐ Mimico gestural (MG) N=60
Comparable to NMV in the child.

ACTS DIRECTED TOWARD OBJECTS

☐ Direct contacts with an object (DCO) N=214
☐ Looking toward an object (CIO(L)) N=254

ACTS DIRECTED TOWARD "SELF"

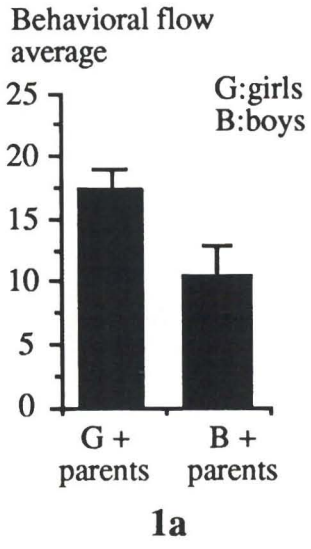
☐ Auto-Contacts (AC) N=1328

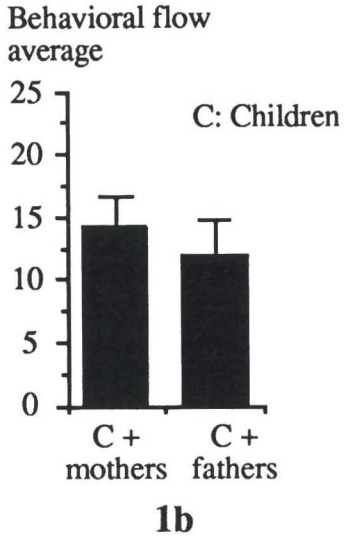
ACTS DIRECTED TOWARD THE CHILD

☐ Direct contacts with the child (DCCh) N=44C
☐ Distancing from the child (DisCh) N=73
☐ Contacts with the child by use of an intermediary object (CCh (obj)) N=225
☐ Approaching the child and coming into contact (ApCh) N=87
☐ Looking toward the child (Ch (Look)) N=1054
☐ Contacts with the child by gestures or voice (CCh (gv)) N=262

ACTS DIRECTED TOWARD THE PRACTITIONER

☐ Movements toward the practitioner (Mvprt) N=42
☐ Looking toward the practitioner (Prt (Look)) N=1150
☐ Contacts through gestures or voice (CGV) N=3151
☐ Study of the behavioral flow.
The period of time in the examining room, despite the standardization of the examination varied between fifteen and twenty minutes, depending on the child-parent pair being filmed. An analysis of variance: (data parametrics) 2 (child) X 2 (parent), demonstrated that regardless of the sex of the child being considered, or that of the accompanying parent, the observed difference (theoretical risk: 5 percent) between the different groups studied was not significant; but due purely to random variation or to factors other than the sex of the child or of the parent. This result justifies the use of absolute frequencies (exact number of each item listed for each subject in each situation) rather than relative frequencies (absolute frequencies per unit of time), throughout the remainder of this work.
☐ The behavioral flow of the children.
The behavioral flow (number of items recorded per subject/unit of time), reflects the entirety of the motor activity of the subject in the examining room. There were differences not only between individuals but also between groups. An analysis of variance (data parametrics) was used to test the significance of these differences.





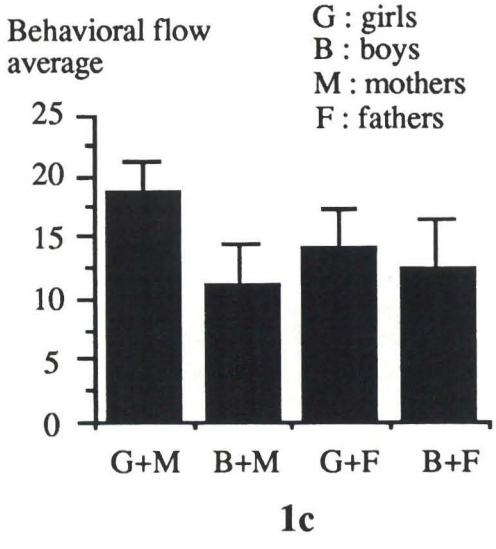
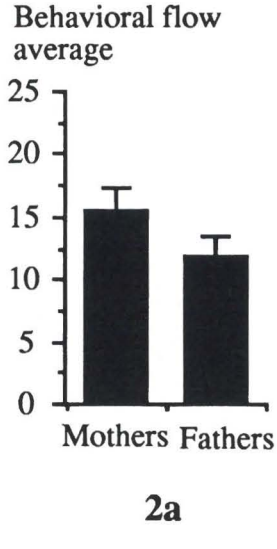
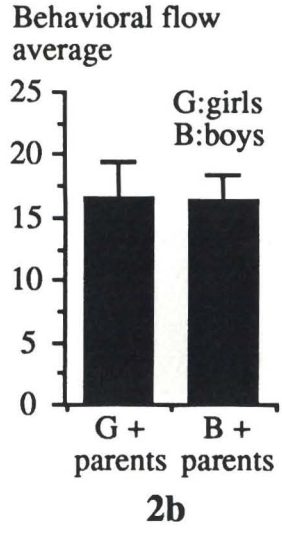


Figure 1. Comparison of the mean flow of behavior of children (number of motor acts/mn) as a function of their sex (Figure 1a), as a function of the sex of the parent (Figure 1b), as a function of the child-parent pair (Figure 1c) with Y error bars (confidence interval: 95 percent) (+/− S.E.M). It appears that the motor activity of children is closely linked to their sex but is independent of the sex of the accompanying parent.





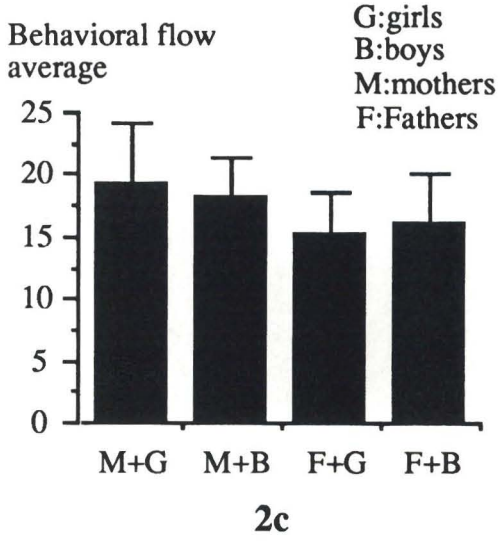


Figure 2. Comparison of the mean flow of behavior of parents as a function of their sex (Figure 2a), as a function of the sex of the child (Figure 2b), and as a function of the child-parent pair (Figure 2c) with Y error bars (confidence interval: 95 percent) (+/− S.E.M). The sex of the child does not contribute to a significantly different level of motor activity by the accompanying parent.

The mean behavioral flow of the girls is significantly ($\underline{P}<.01$) greater than that of the boys, regardless of the sex of the accompanying parent $F(1,36)=15.652$, $\underline{P}<.01$ (Figure 1a). On the other hand, if either the sex of the accompanying parent is taken into account (children+mothers, children+fathers), Figure 1b, or the child-parent pairs are taken into account (girls+fathers girls+mothers boys+mothers girls+fathers), Figure 1c, the difference observed is not significant (a = 5 percent). Thus, it appears that the motor activity of children

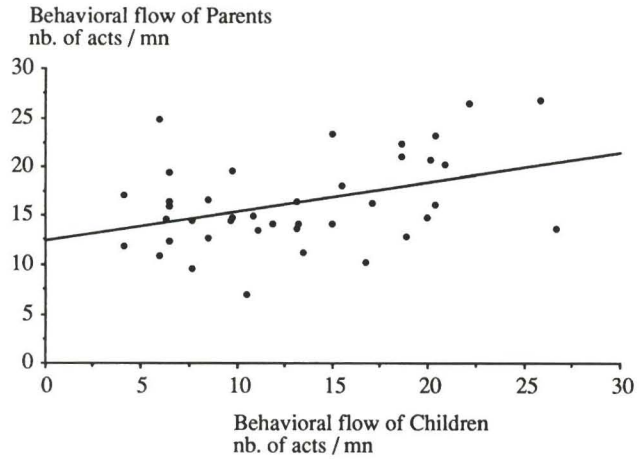


Figure 3. Correlation between the flow of behavior of each child and that of the accompanying parent. A comparison of the relationship for each child-parent pair between the flow of the behavior of the child and that of the accompanying parent, produced a significant correlation. (Y=.302X+12.451), R-squared:.151

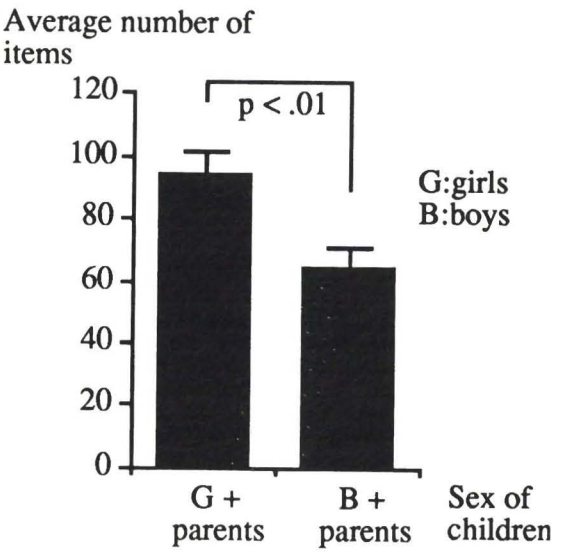


Figure 4a. Comparison of the number of behavior characteristics of security in the children as a function of their sex, with Y error bars (confidence interval: 95 percent) (+/− S.E.M). It appears that the girls manifest significantly more secure actions than do boys, independent of the sex of the accompanying parent.

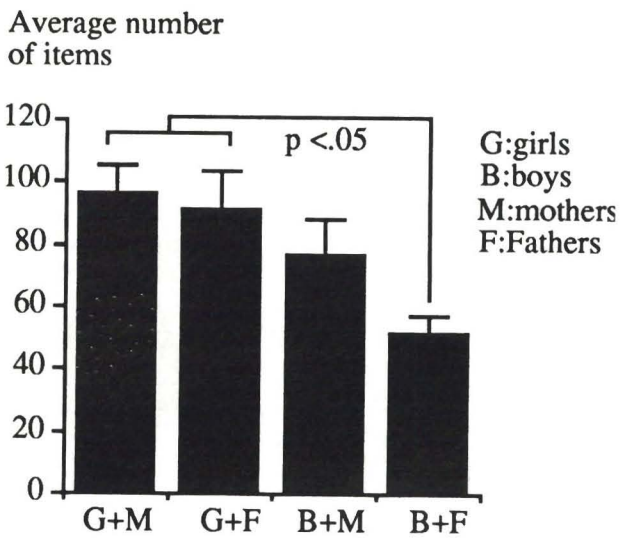


Figure 4b. Comparison of the number of behavior characteristics of security in the children as a function of the child-parent pairs, with Y error bars (confidence interval: 95 percent) (+/− S.E.M). There was a significant difference between the boys when the sex of the accompanying parent was taken into account.

is closely linked to their sex, but is independent of the sex of the accompanying parent.

☐ The behavioral flow of the parents.

The motor activity observed in the parents is closely linked to their sex, with the flow of behavior of mothers being significantly greater than that of fathers $F(1,36)=4.254$ $P<.05$, independent of the sex of the child (Figure 2a). Furthermore, the sex of the child does not contribute to a significantly different level of motor activity by the accompanying parent (Figures 2b, 2c). An analysis of variance (data parametrics) was used to test the significance of these differences.

☐ Correlation of the behavioral flow of the parents with that of the children.

The preceding results show that the female subjects (girls and mothers) manifest more activity than do the male subjects (boys and fathers). A comparison of the relationship for each child-parent pair, between the flow of the behavior of the child and that of the accompanying parent (Figure 3) produced a significant correlation.

The regression line (Y=.302X+12.451) reflects a positive relationship (r=.4) between the child behavioral flow and that of the parent. As the "child" flow increases by 1, that of the parent increases by approximately 1/3.

☐ Measurement of anxiety.

Among all the acts of the children, certain ones can be considered as characteristic of a behavior connoting security within a situation. Others, however, reflect definite anxiety. The consistency between the behavioral

items chosen as being either "secure" or "anxious" items was validated by a multivariate analysis: Factor analysis.[10] Thus, the items characteristic of a behavior reflecting security are: NOD, NOM, P−MvB, +M−V, NM−V, Dispтprt, Prt(look), Cprt(m−v), CPrt+ and the items characteristic of a behavior reflecting anxiety are: Cprt−, −M−V, DCPar+. For the parents, protective behavior is represented by DCCh item.[11]

☐ The "secure" nature of girls and boys.

The "secure" nature of children differs in accordance with their sex, with girls manifesting significantly more secure actions than do boys ($P<.01$), independent of the sex of the accompanying parent (Figures 4a, b). An analysis of variance (data parametrics) permits a more precise comparison of the pairs (girl-mother, girl-father, boy-mother, boy-father). There was a significant difference ($P<.05$) between the boys when the sex of the accompanying parent was taken into account.

☐ Exploratory behavior and the state of security in the children.

Among the different categories of items providing proof of a state of security in the children, the relative importance of displacements (Figure 5) is underscored by a strong correlation ($r=.7$) between the displacements by the girls and boys in the examining room and the secure nature of these children, based on the other items defined above as characteristic of security. The slope is positive (.536) and significant ($P<.05$), reflecting the simultaneous increase of the two variables, displacements and secure character. The more a child tends to manifest an exploratory behavior (displacements), the more secure the child appears to be in the situation. Furthermore, in agreement with the two immediately preceding results, the girls tended to displace more than did the boys ($P<.05$).

☐ A correlation of parental protection and child anxiety.

Based on the "child" items deduced to be characteristic of anxious behavior, it appeared that the "insecure" character of the boys was more pronounced than that of the girls, even though the difference was not statistically significant due to the relatively small number of items that loaded into this category. If on the contrary, we considered in a second stage (Figure 6) the categories of items which characterize anxiety behavior in the children, on the one hand, and acts reflecting parental protection on the other, it appears that parental protection, which is independent of the sex of the child or of the parent (the difference is not significant at a 5 percent risk level) is correlated with the anxiety of the child ($r=.5$).

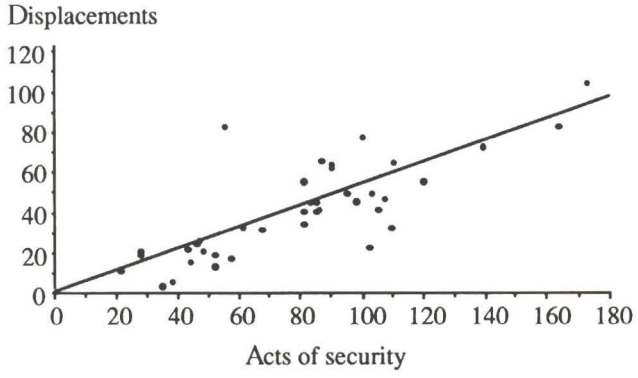


Figure 5. Correlation between displacements and acts of security in the children. It appears there is a strong correlation ($r=.7$) between the displacements by the girls and boys in the examining room and the secure nature of the children. The more a child tends to manifest an exploratory behavior, the more secure the child appears to be in the situation.

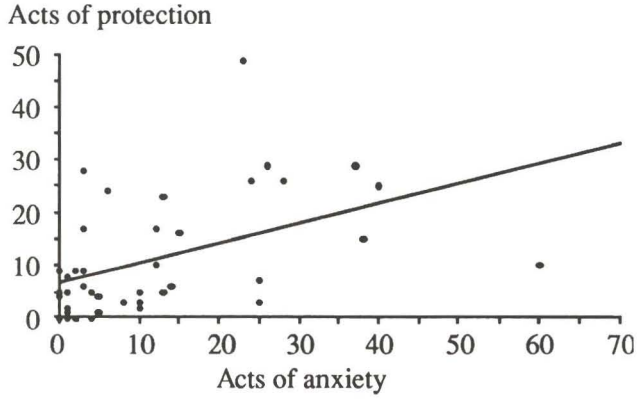


Figure 6. Correlation between anxiety behaviors of each child and the protective behaviors of the accompanying parent. It appears that parental protection, which is independent of the sex of the child or of the parent (the difference is not significant at a 5 percent risk level) is correlated with the anxiety of the child ($r=.5$).

DISCUSSION

The ages between two and a half and three years for the child constitute a turning point, more at the affective than at the cognitive or motor levels.[12] Very rapidly confronted with extra-family partners (play companions in institutions outside the home, day nursery, babysitters, etc.), the toddler must face this emotional security, due to separation from the family at the same time that he

or she must accept the existence of strangers. This period of socialization (alternating phases of openness toward others) appears to be much easier for the child when there is a favorable family context.[13] Indeed, although the mother is the first biological partner of the child, a large number of works show that the maternal tie alone is insufficient for a balanced social, affective, and cognitive development in the toddler.[7,14,15] In fact, a child under three years of age, and complete absence of the father most often lead to difficulties in socialization.[16] These children appear less disposed to separate from a figure of security (e.g. parent) and to display "insecure" behaviors, when faced with unknown situations. Thus, the equilibrium, necessary for a good social anchor within the mother-child-father triangle, seems to be a determining factor in the psycho-affective development of the child.[8,14] In addition to the play companions, the baby-sitter, or the nurse, who can function as mother figures, the child is very rapidly confronted with people in other institutions as well, particularly medical (hospitals, doctor's offices, for example). In the very small child, an encounter with a medical practitioner constitutes not only an experience with a strange adult, but also a new social event.

For example, Raymond was the first to encourage dental surgeons to accept children as patients.[17] As it turns out, the dental surgeons were most often the least cooperative to accept children as patients, due to the fear they engendered in the child. Further, Shirley noted that the child's family environment, and particularly the psychological equilibrium of the mother, were also determining factors in whether or not the child would be receptive to a dental examination. As Shoben and Borland wrote, there is a very fine line between the anxiety level of the mother and that of the child.[19]

The last thirty years of research have permitted a confirmation of these clinical impressions. One study underscored the close correlation between the mother's evaluation of the child's stress level and the behavior of the child at the time of the medical care. Other factors, however, also seem to be origins of the anxiety displayed by the toddler. Thus, at the time of the first medical visit, the presence or absence of the mother in the examining room has an effect on the child's behavior, especially if the child is small. It appears preferable to the practitioner to accept the mother's presence when children are younger than four years, while beyond that age it seems unnecessary.[21]

This entire work demonstrates the influence of the family, and most particularly that of the mother, as a determining factor in the behavior of the small child. Usually, during anxiety-producing situations, the evaluation of the child's anxiety is based on an analysis of tests or of questionnaires presented, most frequently, to the mother. Although the context of a dental examination, which we used as a basis for our research, cannot really be considered a stressful situation (there were only a small number of behavioral items characteristic of anxiety in the child), it does seem, that there is a behavioral difference between girls and boys of the same age, less anxiety displayed by the girls. The girls appear overall more inclined to displacements within the examining room and to voluntarily distance themselves, therefore, from the security figure.

With reference to the works of Ainsworth regarding the ontogenesis of the function of attachment behaviors, it is clear that the tendency to explore an unknown place, thought of as an "at-risk" situation, reflects a behavior connoting security.[5,22] It appears, moreover, that the sex of the accompanying parent can also have an influence; the mothers seem to provide more security to the child. The fathers seem to play a role of reinforcing the prevalent behavior and accentuating insecure behavior in the boys.

In summary, the ethological method permits the study of the motor activity of subjects in a particular situation. It appears that this activity is overall greater in females. Motor activity can, in a way, therefore, be considered as a "marker" of security. Referring to the works of Shoben and Borland, who showed that the level of anxiety displayed by the accompanying parent (in their studies, the mother) was a determining factor in whether or not the child accepted a dental examination, one could suppose that the fathers, by their more static behavior, would augment the insecurity manifested by the boys and have a less powerful influence on the girls.[19] Clarke-Stewart, Yogman, Lamb, showed that in the normal life situation (family setting), fathers tended preferentially to encourage their sons to engage in more physical, dynamic, and "fun" play than did the mothers.[23-25] With their daughters, however, fathers physical contact was reduced and the play was less active. This finding can perhaps explain why in an unusual setting such as that in our study, the behavior exhibited by fathers is more atypical, and thus more anxiety-producing, for the boys than for the girls.

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THE MESSENGER UNDER ATTACK — INTIMIDATION OF RESEARCHERS BY SPECIAL-INTEREST GROUPS

Attacks on health researchers are not new. Pierre Louis, for example, was vilified nearly two centuries ago for suggesting that bloodletting was an ineffectual therapy. In an open society such as ours, controversy is common and often socially useful. The fact that scientists are sometimes challenged by special-interest groups should be no surprise. However, with widening media coverage of health research, growing public interest in health hazards, and expanding research on the outcomes of clinical care, such attacks may become more frequent and acrimonious. The huge financial implications of many research studies invite vigorous attack.

In Marcia Angell's recent Shattuck Lecture, she argued that litigation, fear, bias, and greed interfere with scientific efforts to answer questions of importance to public health and that an antiscientific social attitude encourages premature or ill-informed political and legal solutions to medical questions. She noted that intimidation may cause investigators and institutions with access to critical sources of data to shy away from conducting research on controversial topics.

The sounding board. N Engl J Med, 336:1176–1180, April 17, 1997.

INFANT CARIES

Streptococcus mutans in children using nursing bottles

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Frequent and prolonged consumption of carbohydrate-rich substrates from a nursing bottle may cause a type of rampant caries in infants that is referred to as Nursing Bottle Caries (NBC) or Baby Bottle Tooth Decay (BBTD). This caries process affects surfaces that are usually at low risk. The last few years more attention has been paid to etiologic and preventive aspects, because with a decline of the caries prevalence, it became apparent that a small percentage of children is still highly affected by caries.[1] Different criteria regarding diagnosis of the disease biases the outcomes of prevalence studies.[2,3] Examples of criteria are: decay of the labial or lingual surfaces of at least two maxillary incisors without further restrictions to the location of other carious lesions or age of the patient; decay of at least three of the maxillary incisors; or maxillary incisors affected and further decay in the order of eruption.[4-6] It is important to classify Nursing Bottle Caries in accordance with the latter, combining appearance in the eruption sequence, during which caries attacks, and the type of teeth affected.[6]

Of the four etiologic factors in the caries process, diet and time have been addressed in detail. This regards the sweetened liquids in the nursing bottle, the frequency of use, and use at bedtime. Predeterminants for improper use of nursing bottles or other sweetened pacifiers are found to be related to cultural habits, socioeconomic class, and family composition and size. Moreover, other habits (breast feeding 'at will', sucking on a piece of chocolate during sleep etc.) have also been shown to result in Nursing Bottle Caries.[7,8] Host factors are not well documented. Research on enamel mineralization is hard to perform, because healthy teeth from control patients of the same age cannot be obtained. Studies on salivary factors and immunological responses are still in their infancy. The fourth factor, cariogenic microorganisms, can be demonstrated by the infectious character of the disease and the type and numbers of bacteria involved. Several authors showed high (relative) levels of *S.mutans* to be a risk factor in the disease.[9-15]

Children who use a nursing bottle beyond the regular dietary need do not necessarily develop Nursing Bottle Caries. This indicates special factors influencing the onset of the disease.[14] Even within families the dental health of child-relatives may vary under similar Nursing Bottle Caries-provoking conditions. In these children at least two etiologic factors are apparently similar (diet and time). Differences may be found, therefore, in their microbiological flora, for instance, regarding *S.mutans*. The objective of this study is to compare Nursing Bottle Caries-patients and nonaffected children within families, regarding the numbers and clonal types of *S.mutans*. Both children of a pair in the family had a bottle history. To assess the effect of treatment, the measurements are repeated in the Nursing Bottle Caries-patient after treatment.

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Centre for Special Dental Care (SBT) Amsterdam for providing the patients, and the families for the cooperation in the study.

MATERIAL AND METHODS

In a period of nine months, subjects were selected from the patients of the Centre for Special Dental Care (SBT) in Amsterdam. Special Dental Care is a regional centre where children are referred to by general practitioners because of noncooperative behavior during regular dental treatment. During a routine admission the parents of Nursing Bottle Caries-patients were asked whether a brother or sister showed a similar dietary behavior (bottle history), that did not result in Nursing Bottle Caries. These families were invited to attend another session.

The mother, the Nursing Bottle Caries-patient and the unaffected brother or sister (control) of seven families were then dentally examined. The criteria for Nursing Bottle Caries were adopted from Veerkamp and Weerheijm.[6] Brief medical histories were taken and the bottle behavior was recorded. Two pairs of children were apparently identical twins. From the patient, the control and the mother non-pooled plaque was sampled using a probe. Sample sites were: labial surface of left central incisor and buccal surface of a posterior tooth (the 65 with children and 26 with their mothers). In the Nursing Bottle Caries-patients, the anterior sample was taken from a carious site. Saliva was sampled from the tongue using a 10 µl-loop. The dental examination and sampling procedure of the Nursing Bottle Caries-patient was repeated after four to seven months posttreatment (sampling from mandibular incisors, if maxillary anterior teeth were extracted). Treatment included restorations and extractions, performed in a regular setting or using general anesthesia.

The plaque and saliva samples were kept in 0.9 ml RTF and processed within a few hours.[16] The specimens were ultrasonic dispersed (10 times 1 sec). 0.1 ml of a tenfold dilution was plated onto the *S.mutans* selective medium TYCSB and incubated anaerobically at 37°C for two days.[17] For assessment of the salivary number of colony forming units (CFU), colonies of *S.mutans* from the tongue samples were counted as identified by their morphology.

The plates with plaque samples were prepared for *S.mutans* type-screening. If present, more than thirty colonies per subject were randomly selected, colonies with different morphologies were selected deliberately. This selection procedure assures that more than 90 percent of the strain types of *S.mutans* present in the sample will be obtained with 95 percent confidence.[18] The selected colonies were subcultured on blood agar and stored in skimmed milk at −80°C until further use.

The clonal types of the isolates were distinguished using a random primed polymerase chain reaction (RP-PCR) on the isolated DNA of the bacterial cells.[19,20] The cells stored in skim milk were put in a sixteen-hour culture in BHI-broth (1 ml) and harvested by centrifugation. 100 µl Triton X-100 was added to obtain lysis at 95°C. 5 µl of this suspension were added to a standard RP-PCR-mix, using the DNA-primers 5'CCGGCGGCG and 5'GTAAGGCCG. The RP-PCR settings were: 35 cycles of denaturation at 94°C (1 min), annealing at 32°C (30 sec) and elongation at 72°C (1 min). The amplimers were made visible by using a standard agarose gel-electrophoresis and staining with ethidium bromide. Differences between isolates were made visible by comparing the gel-electrophoresis patterns of the amplimers (Figure 1).

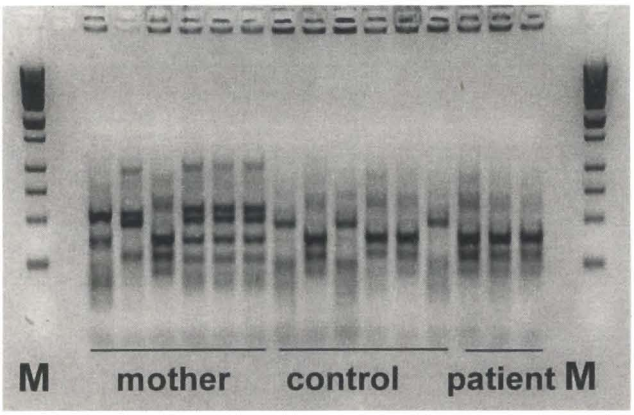

Figure. Several strains of S.mutans *of one family as observed by gel-electrophoresis after ap-pcr. M=molecular weight marker. Each lane contains pcr-products (DNA) of one strain.*

RESULTS

The educational and growth experiences of patient and control were similar. In two families both parents were employed, whereas in the other five, the male was working professionally. One family was of recent immigrant origin. There were no signs of hereditary or congenital hypomineralization of the enamel; hygiene practices within families were similar. In Table 1 more detailed information is shown on dmft, medical histories, dietary and bottle habits. Four of the mothers had a DMFT>18, which made them highly caries-active individuals; three mothers were scored as moderate caries-active (7<DMFT<11). We were not able to find essential dissimilarities between the patient and the control regarding the frequency and the content of the bottle. Moreover, two of the older children (controls)

Table □ Data regarding age, gender, medical histories, and bottle behavior.

	Family		Age	Gender	dmft (dmft) /stage	Medical history	Period of bottle usage	Content	Reason	CFU (CFU)
1	mother: DMFT = 10	patient	3.2 yrs	♂	12 (14) /3	allergic to gluten	bedtime; up until 2.5 yrs; < frequent than brother	concentrated fruit-solution	brother as example	5.9 (1.5)
	32 yrs CFU:5.4	control	4.9 yrs	♂	1	n.p.	bedtime; up until 3 yrs	concentrated fruit-solution	sleeping problems	0
2	mother: DMFT = 1	patient	3.0 yrs	♀	11 (12) /3-4	n.p.	whole day; @	milk	pacifier, sleeping problems	5.0 (1.5)
	22 yrs CFU:3.0	control	4.1 yrs	♂	2	n.p.	whole day	milk	pacifier, sleeping problems	3.7
3	mother: DMFT = 8	patient	4.8 yrs	♂	16 (16) /4	CARA and AB-therapy	to get asleep; up until 3 yrs	buttermilk and syrup	no special reason	6.0 (4.9)
	31 yrs CFU:5.0	control	4.8 yrs	♂	4	CARA and AB-therapy	to get asleep and bedtime; up until 3 yrs	buttermilk and syrup	no special reason	0
4	mother: DMFT = 22	patient	4.5 yrs	♀	12 (12) /3	n.p.	during day up until 1.5 yrs; bedtime up until 2.5 yrs	syrup	to get asleep	4.6 (1.3)
	39 yrs CFU:6.4	control	4.5 yrs	♀	1	delivery problems	during day up until 1.5 yrs; bedtime up until 2.5 yrs	syrup	to get asleep	3.3
5	mother: DMFT = 22	patient	3.9 yrs	♀	16 (16) /4	more regularly ill than sister	during day and bedtime; #	sweetened milk drinks	pacifier and feeding	5.8 (4.3)
	39 yrs CFU:5.0	control	10.7 yrs	♀	2	n.p.	bedtime; up until 9 yrs	sweetened milk drinks	pacifier and feeding	5.0
6	mother: DMFT = 19	patient	3.2 yrs	♂	13 (15) /4	n.p.	during day and bedtime; #	syrup	pacifier and feeding	6.2 (6.1)
	34 yrs CFU:3.6	control	6.3 yrs	♂	6	n.p.	during day and to get asleep; up until 4 yrs	syrup	pacifier and feeding	3.7
7	mother: DMFT = 18	patient	3.1 yrs	♂	7 (7) /3	n.p.	during day and bedtime; @	concentrated fruit-solution	pacifier and feeding	7.0 (6.5)
	42 yrs CFU:5.3	control	4.5 yrs	♀	1	n.p.	during day and bedtime	conc. fruit-sol, sweetened milk drinks	pacifier and feeding	4.7

(dmft) = dmft 4-7 months after treatment, stage = severity of NBC according to Veerkamp and Weerheijm[6]
CFU = log (CFU *S.mutans*)/ml saliva, (CFU) = log (CFU) 4-7 months after treatment. Medical history: n.p. = no peculiarities
Bottle usage: # = still using the bottle 4-7 months after treatment; @ = weaned from the bottle 4-7 months after treatment, high sweets intake

exhibited a bottle behavior that should expose the child to a higher risk for caries than the patient. The controls were affected with caries to a certain extent, but this could certainly not be identified as Nursing Bottle Caries. From six patients, at least the maxillary incisors were extracted, which reflects the severity of the cases with Nursing Bottle Caries.

The patients had 5.8 log(CFU)/ml (± 0.8) saliva as obtained from the tongue (Table). The controls had a mean of 2.9 log(CFU)/ml (± 2.1), which is statistically different compared to the patients (Wilcoxon matched-pairs signed-rank test, p=.02, two-sided). In the mothers, *S.mutans* was always found (mean 4.8 log(CFU)/ml (± 1.2); Table). Several months after treatment the CFU/ml of *S.mutans* decreased by more than ten times in five patients. In two patients, CFU were comparable to baseline sampling (> 10^6), one of these still using the bottle. In the group with decreased CFU, also one child did not wean from the bottle.

With the DNA typing procedure, only one clonal type of *S.mutans* could be found in each Nursing Bottle Caries-patient (at the carious sampling site (incisors), the noncarious site (molars) and also on the tongue). The controls had more variation in their *S.mutans*-flora and harbored two to five strains of plaque on the incisors as well as on the molars.

DISCUSSION

The relationship between Nursing Bottle Caries and *S.mutans* has previously been shown by comparing Nursing Bottle Caries patients with healthy children, but it is unclear whether the unaffected individuals in these studies also used a sweetened nursing bottle.[11,12] For the purpose of comparison, case-control studies are most appropriate. Matching for dietary behavior (especially prolongation and frequency of bottle use), and also for age, gender, general health and SEC-factors, however, is tedious. Families were reported where the use of a sweetened nursing bottle is habitual (without affecting all children). Hence, study within these families seems to meet some of the matching problems. Even then assumptions of similar behavior have to be included, since detailed information on the older child is retrospective in nature. Nevertheless, the two twin-families in the present study, where more factors are stable, provide adequate support for the reliability of the data. Additionally, research is hindered by the relatively advanced age of the children, since parents of Nursing Bottle Caries-children usually seek professional support in an advanced stage of the process.

High numbers of *S.mutans* in saliva correlate well with a high caries risk.[21,22] Weinberger and Wright found

a relationship between salivary *S.mutans* counts and those on the mucosal surface of the tongue.[23] In this study, accordingly, tongue samples were used, because it is difficult to obtain a salivary sample just by expectorating in young children with rampant caries. The high caries risk for the Nursing Bottle Caries patients in comparison to the non-Nursing Bottle Caries children within families was confirmed by higher counts of *S.mutans*. The correlation between CFU and caries risk was, however, not clear between families, since the control in family 5 harbored as many CFU as the patients in families 1 and 4. In six patients more than 10^5 CFU were found. This is in accordance with the previously reported association between dmft and CFU in young children.[24] Preferably, *S.mutans*-CFU should decrease after prevention (weaning from the nursing bottle) and treatment of cavities. It is not sure yet whether the higher numbers of *S.mutans* lead to Nursing Bottle Caries or that Nursing Bottle Caries itself contributes to the high prevalence of *S.mutans*.

From the literature available, Berkowitz concluded that *S.mutans* is usually not found in children before one year of age, indicating that the etiologic factor 'microorganisms' is absent during eruption of the primary incisors.[25] This is in contrast with anecdotal observations where parents of Nursing Bottle Caries-children sometimes report that the maxillary teeth of their children 'erupted already brown'. Moreover, Brown *et al* did detect *S.mutans* in teething children who had one to four teeth erupted.[12] It may be suggested, therefore, that Berkowitz' conclusion is merely based on healthy individuals who do not easily develop caries. Nursing Bottle Caries-children may acquire the cariogenic flora earlier. This is in agreement with data from Köhler *et al*, who report that the moment of first colonization by *S.mutans* is inversely related to the affection by caries.[26] High CFU in the mothers promote this colonization process.[12,27] High-CFU mothers in our study have children, however, with different CFU within their families (even within twins). Additional factors must be involved in the colonization and it can be hypothesized that the age when the first tooth erupts and the interaction with the child's developing immune system determine the onset of the disease.[28]

In principal it may be questioned whether only one strain of *S.mutans* in the flora provides for a noncarious condition or whether various strains assure a stable, nonpathogenic bacterial plaque. Recently Alaluusua *et al* observed that Nursing Bottle Caries-patients are colonized with several strains, which is contrary to our results.[15] In that study no clear distinction was made between the species *S.mutans* and *S.sobrinus*. In patients where only *S.mutans* was found, 50 percent harbored just one strain. Furthermore, *S.sobrinus* is not likely to be found in healthy patients, and given the few isolates that were selected, it might not be unexpected to find only one strain in caries-free children in the Alaluusua-study, due to a moderate confidence in obtaining the strains of a sample.[24] At a 90 percent detection level, our results reflect an inverse relationship between the number of clonal types of *S.mutans* and Nursing Bottle Caries. This suggests a selection of strains in Nursing Bottle Caries patients. Selection for the strongest and most virulent strain of *S.mutans* may occur when oral homeostasis is disturbed, possibly due to low oral pH. If only one type of strain is involved in all Nursing Bottle Caries-patients, this may be an opportunity for specific antimicrobial therapy.

The present results suggest a more complicated etiology for Nursing Bottle Caries than the bottle behavior alone. Etiologic host factors like enamel maturation and mineralization should ideally be documented. Regarding microorganisms, we expected high counts of *S.mutans* in both patient and control, because of the rich carbohydrate diet. This was not confirmed, however, and the difference observed for CFU may be caused by salivary factors, such as the individual sugar retention time. Based on the present results, the microbiologic CFU-screening for the assessment of Nursing Bottle Caries-risk does not yield consistent predictive figures. It may be supplemented by clonal typing of *S.mutans* to gain reliability. The similarities of the chromosomal DNA patterns of strains in this study need to be further explored, just as do their cariogenic potentials.

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MANAGED CARE

Leaders of the managed-care companies maintain that they can continue to deliver effective care to the American people at a sustainable cost only by closely controlling the practice patterns of hospitals and physicians and by limiting the choices available to their enrollees. But increased numbers of plan members have begun demanding that the federal and state governments use their regulatory powers to ensure that the plans do not engage in policies and practices detrimental to enrollees' health. Finding the balance between the degree of control the managed-care plans need in order to give their members cost-effective care and the degree of assistance the members seek from regulatory authorities to be sure that they are not being exploited, and their health endangered, is a challenge that, once it has surfaced, will not be readily resolved or set aside.

Moreover, the rapid expansion of enrollment in managed care has not prevented the estimated overall spending for health care in 1995 from increasing by 5.4 percent to a level just short of $1 trillion ($988 billion). If one considers the period from 1980 to 1995, a decade and a half in which managed care grew very rapidly, overall health care outlays quadrupled, from $250 billion to $1 trillion (in current dollars).

There is no need to consider further developments, current and emerging, that argue against simple extrapolation based on the recent rapid growth of managed-care enrollment. Even if this trend is sustained into the future, the critical forces identified here are likely to ensure that managed care, of and by itself, will be unable to answer the needs of the American people for universal coverage, sustainable financing, and better care. Unfortunately, the solution to these problems lies beyond the inherent capabilities of the managed-care system.

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Feeding practices and dental caries in an urban Canadian population of Vietnamese preschool children

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The prevalence and severity of tooth decay in children have declined dramatically during the last couple of decades.[1-4] Indeed, surveys by the National Institute of Dental Research demonstrate that 50 percent of the dental caries appears to affect only 12 percent of children.[1,5] Usually it is children of lower socioeconomic status who demonstrate these patterns of extensive dental decay.[6-8] Often new immigrants to industrialized countries such as Canada find themselves to be economically disadvantaged, and, consequently, young children from these immigrant groups may suffer from severe dental problems. The first Vietnamese boat people arrived in Canada in 1979. Vietnamese immigrants compose the fifth largest group of people who have recently moved to Canada's most western province, British Columbia (B.C.); their estimated population in 1995 in B.C. was about 25,000. Before coming to Canada, the refugee experience of these Vietnamese immigrants included poor nutrition, lack of adequate medical and dental care, cramped living quarters, and limited educational opportunities. Dental health and use of professional dental services were traditionally not a major priority for Vietnamese families in their own country. Although little published data are available on oral health of Vietnamese children living in Canada, results of surveys from other countries demonstrate a high prevalence of dental caries in the primary dentition of young Vietnamese children.[9-14] In order to promote improved oral health in Vietnamese children, culturally-sensitive, community-based approaches to oral health promotion that address the social factors that contribute to severe and extensive dental decay should be considered.[15]

The objectives of the project described in this paper were

- ☐ To determine the prevalence of dental caries in a convenience sample of Vietnamese infants and preschool children in British Columbia, Canada.
- ☐ To gather and analyze information about current practices related to dental health and nutrition in this group of children.
- ☐ To use this information to design a culturally-specific oral health promotion program, developed with the input of the Vietnamese community.

The project began with information-gathering (Objectives 1 and 2); it is only this component of the project that is reported in the following paper.

METHODS

The majority of families involved in the project were clients of a Child Health Clinic (CHC) for Vietnamese fam-

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ilies sponsored by the Health Department of the city of Vancouver, British Columbia. All families who attended these twice-monthly clinics over a six-month period were invited to participate. The Clinic, whose staff are fluent in the Vietnamese language and familiar with the culture, provides well-baby and immunization services; mothers bring their infants for two, four, six, twelve, and eighteen month immunizations. Older preschoolers routinely attend with their younger siblings.

All mothers were interviewed in the Vietnamese language by the community dental health worker (YP), a lay worker specifically hired for the project. The community dental health worker was trained in interviewing skills by Vancouver Health Department (VHD) staff. The interview instrument attempted to assess demographic variables, infant feeding and comforting practices, and dental health knowledge and practices. The instrument was literacy-tested and translated into Vietnamese. Informed written consent was obtained from all mothers.

Mothers were interviewed regarding the infant that they had brought for well-baby care, and were also interviewed about their other preschool and young school-age children. All children, including infants, had an oral examination performed by the project's dental hygienist (BC), who had been calibrated to examination criteria by one of the project's dentists (TW) at a Vancouver Health Department Dental Clinic. The examiner was unaware of a parent's answers to the interview. The examination was performed following the interview with the child in the lap-to-lap position, using a mouth mirror, explorer, and flashlight. A tooth was considered to be carious, if there was visible evidence of a cavity that was thought by the examiner to involve the dentine.[16] The probe was mainly used to remove plaque. Children were classified to have nursing caries, if two or more maxillary anterior teeth had decay.[17] No radiographs were exposed on any of the children.

The protocol for the project was approved by the Behavioral Sciences Screening Committee for Research Involving Human Subjects of the University of British Columbia.

Simple frequencies, means, and ranges were determined, and correlations were explored by Chi-square analysis.

RESULTS

☐ Demographic variables

In total, data were collected on sixty mother/child pairs; it was not possible to do interviews for three children, and occasionally a question was not answered. Table 1 presents demographic information on the sample.

Table 1 ☐ Demographic variables for mother-child pairs, N = 60.

	Mean ± S.D.	Range
Age of child (months)	32.4 ± 21.3	3–74
Age of mother (years)	32.0 ± 5.6	24–46
Number of children in family	2.3 ± 1.2	1–6
Years in Canada	5.1 ± 3.6	1–14

Gender distribution of the children was 48 percent female and 52 percent male. The majority of mothers, 67 percent, considered theirs to be a single parent family, and most mothers, 68 percent, had no regular help with child care from family or friends, other than that provided by the child's father. About 68 percent of mothers had not completed high school. None of these variables was statistically related to the children's caries experience.

☐ Dental caries

Table 2 presents the caries experience of the children examined. The percentage of children eighteen months of age or older with nursing caries was 64 percent; no child less than eighteen months of age had nursing caries.

☐ Infant and toddler feeding practices

Two-thirds of mothers had breast-fed or were breast-feeding their children; the majority, 57 percent, stopped breast-feeding when their children were under six months of age. Breast-feeding was supplemented with a bottle by 77 percent of mothers.

All children younger than eighteen months were still on a bottle. Information on bottle-feeding habits was available for thirty-one of the children, eighteen months of age or older. Sixteen, or 52 percent, of these children were still on a bottle; age of the children who still had a bottle, mean ± S.D., was 32.0 ± 11.2 months. The oldest child still using a bottle was forty-nine months. Cow's milk was the most popular beverage in the bottle; milk in the bottle was positively correlated with nursing caries, $P = 0.05$ (Table 3). No sugar or other flavorings were added to the milk. Of the children who had been successfully weaned off the bottle, 73 percent of them had not been weaned until after the age of two years.

The use of a "comfort" bottle, a bottle a child carries and drinks from on an *ad lib* basis was reported to be a current or past behavior in 87 percent of children eighteen months of age or older. Of these children, 65 per-

Table 2 ☐ Dental health of children examined.

	n	Age, months Mean (S.D.)	Percent caries free	deft Mean (S.D.)	deft Range	defs Mean (S.D.)	defs Range
Age							
< 18 months	21	9.9 (4.4)	100%	0.0 (0.0)	—	0.0 (0.0)	—
≥ 18 months	39	44.5 (16.2)	20.5%	8.4 (4.6)	0 – 16	14.9 (14.7)	0 – 56

Table 3 ☐ Feeding practices by caries group for children 18 months and older.

Variable	Nursing caries	No nursing caries	Test statistics
defs	22.3 ± 13.4	3.0 ± 6.5	$t = 5.98$; $P = 0.000$
Child was breastfed	72.7%	73.3%	$X^2 = 0.00$; $P = 0.97$
Child was breastfed until older than 6 months	75.0%	27.3%	$X^2 = 6.01$; $P = 0.01$
Regular bottle while breastfed	57.1%	80.0%	$X^2 = 1.37$; $P = 0.24$
Milk most frequent beverage in bottle when child > 1 yr	92.9%	60.0%	$X^2 = 3.81$; $P = 0.05$
"Comfort" bottle	100.0%	71.4%	$X^2 = 5.27$; $P = 0.02$
Naptime bottle	88.2%	60.0%	$X^2 = 3.38$; $P = 0.07$

Table 4 ☐ Dental health practices by caries group of mother and child.

	Nursing caries	No nursing caries	Test statistics
Mother feels child's teeth are fair/poor	96%	33%	$X^2 = 16.48$; $P = 0.00$
Child cleans own teeth	96%	80%	$X^2 = 2.21$; $P = 0.14$
Use toothpaste daily	91%	67%	$X^2 = 3.14$; $P = 0.06$
Child been to dentist	50%	7%	$X^2 = 7.64$; $P = 0.01$
Mother never been to dentist	23%	20%	$X^2 = 1.56$; $P = 0.46$
Mother feels her own teeth are fair/poor	64%	69%	$X^2 = 0.11$; $P = 0.74$

cent had nursing caries. A "comfort" bottle was significantly related to presence of nursing caries, P = 0.02 (Table 3). For 85 percent of children, milk was the most frequent beverage in this comfort bottle. A sleep-time bottle was, or had been, a regular habit for 78 percent of children. The prevalence of nursing caries was 63 percent in this group of children, and mothers of 97 percent of children reported milk to be the most frequent beverage in the sleep-time bottle. The correlation between a sleep-time bottle and nursing caries was P = 0.07 (Table 3). All mothers reported that they removed the bottle when its contents were finished.

Of the children eighteen months of age or older for whom we had infant feeding information, six of them (16 percent) had never had a bottle. Five of these six children, however, had nursing caries, and increased caries experience. Their defs, mean ± S.D., was 28.0 ± 19.4. The majority of these children, who had spent their early years in a refugee camp, were breast-fed on demand until the age of two years.

All mothers were questioned about other aspects of their children's diets. More then half of children, 55 percent, over a year of age had fruit juice daily, and 87 percent had fresh fruit daily. Pop, Koolaid or other fruit drinks were drunk at least daily by 24 percent of children; daily candy was reported by only 9 percent of children. These dietary habits were not significantly correlated with presence of nursing caries.

☐ Dental practices and beliefs

Mothers were asked about their own dental health practices and those of their children, Table 4. In addition beliefs and attitudes regarding general aspects of dental health were explored using true-false statements (Table 5). The percentage of correct responses from all mothers interviewed are listed, and the percentage of correct responses

Table 5 □ Attitudes and beliefs regarding dental health.

	"Correct" response	Percent "correct" responses: All mothers*	Nursing caries	No nursing caries	Test statistics ^
Most children have cavities in their baby teeth	F	9%	4.5%	13.3%	$X^2 = 0.92$; $P = 0.34$
Letting a child frequently carry around and drink from a bottle with milk or juice can cause cavities in the baby teeth	T	100%	100%	100%	—
It is possible to never have a cavity in your teeth.	T	33%	22.7%	26.7%	$X^2 = 0.08$; $P = 0.78$
Bottle-feeding a child until he is 3 years old increases his chances of having bad teeth.	T	93%	95.5%	86.7%	$X^2 = 0.92$; $P = 0.34$
A preschool child can do a thorough job of brushing his teeth by himself.	F	47%	54.5%	33.3%	$X^2 = 1.61$; $P = 0.20$
No matter what you do, you will lose most of your teeth by the age of 60.	F	33%	27.3%	20.0%	$X^2 = 0.26$; $P = 0.61$
Cavities are not a problem in baby teeth because they do not cause pain, and baby teeth fall out anyway.	F	37%	31.8%	40.0%	$X^2 = 0.26$; $P = 0.61$
Frequently drinking apple juice can be harmful to children's teeth.	T	75%	81.8%	80.0%	$X^2 = 0.02$; $P = 0.89$

*Percent correct responses from all mothers, including mothers of children < 18 months
^Test statistics compare mothers of children ≥ 18 months with and without nursing caries

from mothers of children with nursing caries are compared to the percentage from mothers of children who did not have nursing caries. No significant differences were observed in correct responses between these two groups of mothers.

DISCUSSION

Compared with some other reports, the size of the sample reported here is small. These data were gathered, however, to be used in planning an oral health promotion program specific to the needs of an urban community of Vietnamese families. The purpose of the information-gathering phase of the project, which is reported here was to determine the severity of dental caries in preschool children from the community who would participate in the health promotion. In order for any community-based health promotion intervention to be successful, it is essential that members of the target community be aware of the severity of the problem in their community.[18]

It is also essential to identify those feeding and parenting practices that might be associated with the caries experience of these young Vietnamese children. Caries was not yet a problem, and was not observed, in children younger than eighteen months of age. Performing an oral examination for these children, however, was done to reinforce to parents the importance of oral health in their children's overall general health. In addition it was important to interview parents of these young children to discover what child-rearing practices might be present that would contribute to caries at a later age. The fact that caries was observed in one child who was only eighteen months of age demonstrated the importance of beginning an oral health promotion program for children at an early age.

Despite the modest sample size, the prevalence and severity of dental caries in the children examined in this study were similar to that reported in previous surveys of caries of the primary dentition in Vietnamese children who have left their native country.[9-14] Considering that a recent survey of dental caries reported that in the Pacific region of the U.S, the dft of five-year-olds (mean ± S.E.) was 2.0 ± 0, the deft of 8.4 ± 4.6 observed in the children in this study was alarming.[5] This average deft of 8.4 was almost identical, however, to that reported in a 1986 survey of five-year-old Vietnamese children in London.[14] No child over forty months was caries-free in our study sample; in B.C., 45 percent of five-year-olds in the general population have been reported to be caries-free.[3] The children who were included in our project demonstrated a staggering amount of dental disease.

This epidemiological diagnosis demonstrated the severity of decay in the children examined. In order to change those behaviors contributing to this serious oral health problem, individual parents and the overall community must be made aware that dental decay in their children exists, and that this problem is undesirable. This principle is one of the primary concepts in behavioral theory as it applies to patient counseling.[19] Unless parents view badly decayed primary teeth as unhealthy and unwanted, they will not adopt behaviors to promote better oral health for their children.

Mothers of children with nursing caries agreed that their children's teeth were "fair/poor" (Table 4). It was also apparent from the replies on the attitudes portion

of the questionnaire that it was thought to be true by the majority of mothers that "most children have cavities in their baby teeth" (Table 5). This statement is correct for the community of Vietnamese children that these mothers see, but is not true for the majority of preschool children.[5,20] Almost two-thirds of mothers felt, however, that cavities were "not a problem in baby teeth because they do not cause pain, and baby teeth fall out anyway." It seems that decay in primary teeth is known to be a common occurrence, but is not considered to be a "problem." A necessary component of the oral health promotion, therefore, would be to educate parents about the negative effects on a child's health and well-being of poor primary teeth. Until parents are aware of these effects, they may not be willing to adopt behaviors that will encourage better oral health for their children.

Many factors probably contribute to the poor dental health of Vietnamese children. Children's diets may be less than ideal because parents are unfamiliar with the products available on grocery shelves in Vancouver. Often sugary snacks may be used to pacify a fussy child, and parents may not be aware of the effect that this practice may have on their children's teeth. In addition, parents may not know of the potentially detrimental effect on the dentition of putting a child to bed with a bottle of milk or juice, or allowing a child to walk around, using a bottle as a pacifier or "comforter." All mothers that were asked, however, knew that carrying around a bottle with milk or juice can cause cavities in the baby teeth (Table 5). Despite this knowledge, all children under eighteen months, and over half of children eighteen months of age or older, in this study, still had a regular bottle. Weaning a child from a bottle before the age of two years was uncommon. It was routine for children to have a "comfort bottle"—a bottle that was carried around throughout the day and drunk from at will. Even a majority of the toddlers under eighteen months of age had a "comfort" bottle. A sleep-time bottle was also a common habit. Routinely milk was the beverage in the bottle. These harmful bottle habits were significantly associated with nursing caries in the older group of children. These results from the interviews supported anecdotal observations of the CHC staff regarding the frequency of bottle use among their Vietnamese child clients.

It is worthwhile exploring the perceived importance of milk in the diet of young Vietnamese children. Healthy growth and development of their children is of paramount importance to Vietnamese parents. They appear to have embraced the message of milk being the "perfect" food and necessary for their children's health and well-being. Young babies become accustomed to a frequent bottle of formula or milk from early infancy, and once established this "bottle" habit is difficult to change. Often parents may try to wean a child around the age of one year; but, this switch-to-a-cup means that the volume of milk that the child drinks decreases appreciably. Parents, alarmed over the smaller volume of milk, and the fussiness accompanying the switch to a cup, quickly revert to the bottle. As observed in this group of children, a bottle often remains a regular habit for children up to and beyond the age of four years. Education of parents about the daily amount of milk actually required by a child, and about alternate sources of calcium in the diet would be recommendations of the committee designing the health promotion program. Parents also needed to be reassured that a certain amount of fuss, crying—and mess—are to be expected and are normal during this weaning stage.

A small number of children, n = 6, in the study sample had never had a bottle. The majority of these children were born, and spent their early years, in refugee camps. Because of the deprivation and severe conditions of camp life, their mothers had limited access to infant formula and fresh pasteurized milk. As a result, these children were breast-fed at will until about the age of two; the majority of these children had nursing caries, and the average defs was 28.4. This relationship between nursing caries and prolonged breast-feeding has been reported by other investigators.[21-23] Because of the compromised nutritional status, however, during the formative stages of the primary dentition of these children, etiologic factors in addition to prolonged and continuous breast-feeding probably also contributed to their extensive caries.

Although results from this sample of children demonstrated a correlation between nursing caries and continuous and constant ingestion of milk, studies involving animals do not support the cariogenic potential of milk. Recent investigations using a rat model suggest that milk may actually have cariostatic properties when ingested at the same time as a cariogenic challenge.[24,25] It must be remembered that milk, however, was not part of these children's diets under usual dietary conditions. Exposure to milk was frequent, prolonged, and constant, whether it was milk in a bottle, or breast milk.

The majority of the children in this study began eating solid foods around six months of age. It was important, therefore, to examine the influence of other foods in the diet that may contribute to poor dental health. Several investigators have demonstrated that an established pattern of sugar consumption in infancy is maintained throughout the first years of childhood.[26,27] The data on other dietary habits that were initially gathered did not

provide any statistically significant associations, probably because these data did not provide sufficient information about details such as frequency of ingestion.

Using the information that has been gathered, informed planning of the oral promotion program by a Planning Group, which includes members of the Vietnamese community, health unit staff who work with the Vietnamese community, the project's dental hygienist and the community dental health worker is now in progress, and the program is underway. A careful evaluation of the process, impacts, and outcomes of the health promotion is ongoing.

CONCLUSIONS

- ☐ Inappropriate bottle-feeding habits are one of the factors related to the high prevalence of nursing-caries in urban, immigrant preschool Vietnamese children.
- ☐ To change behaviors related to poor dental health in Vietnamese children, the community must be aware of the importance of primary teeth, and how serious a health problem decay in primary teeth can be.
- ☐ Oral health promotion programs for immigrant Vietnamese children should begin in infancy, and be designed with the input of the Vietnamese community.

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CLINIC

Microscopic studies of accessory canals in primary molar furcations

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The close interrelationship between the pulp and the periodontal ligament has been documented in dental literature for a very long time. Communication between the pulp and the periodontal ligament takes place via the apical foramen, lateral and accessory canals in the apical and the coronal parts of the roots.[1] As a result much interest has been directed toward the relation between endodontic and periodontal disease in the permanent dentition. Periodontal disease is often present in the furcation area of permanent molar teeth with inflamed or necrotic pulps.[1-3] Conversely a primary periodontal lesion may cause pulpal pathosis via lateral and furcation canals.[4] In primary molars pathological bone changes following pulpal inflammation are not likely to be found at the apices, but in the interradicular furcation region.[5] A few investigators have studied the canals that connect the pulp-chamber floor and the furcation area in primary molars, in an effort to evaluate the possible pathological consequences of this relationship.[6-12] The results obtained from these studies are not in total agreement, with variations related to the methodology used in the studies.

A variety of techniques has been used to study the anatomy of the root canal system. Hess, utilizing a vulcanite perfusion technique, found that 17 percent of 3000 permanent maxillary and mandibular teeth had accessory root canals.[13] Vessels in the bifurcation and trifurcation of human primary and permanent molar teeth, connecting the pulp and periodontal membrane have been described.[14] Topographical studies have confirmed the presence of accessory foramina in the furcation region of permanent molars.[15,16] According to the studies of Burch and Hulen, 76 percent of maxillary and mandibular first and second molar furcations exhibited multiple foramina in the furcation areas.[15] A SEM study of the furcation surfaces of eight mandibular and seven maxillary molars demonstrated numerous foramina that varied in size and distribution.[16] A radiopaque dye study demonstrated a 59 percent frequency of patent accessory canals in the coronal and middle thirds of the roots of forty-six permanent maxillary and mandibular first and second molars.[17] Accessory canals were found in the furcation regions of 46 percent decalcified and dye-injected mandibular first molar teeth.[18] Winter examined 100 abscessed primary molars for accessory canals in the furcation regions.[11] Dye solution was injected from the pulp chamber toward the furcation. Furcation canals were demonstrated in 23 percent of the specimens. In another study, the pulps of 100 primary molars were macerated and subsequently injected with silicone elastomer, whereas the root canal systems of fifty teeth were replicated with epoxy resin. Fine root canal ramifications were seen and numerous accessory root canals were re-

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vealed. No accessory canals were found in the furcation regions.[10] Studies utilizing techniques including injection of material into the root canal system, dye perfusion, light and electron microscopy cannot demonstrate the complex root canal system in detail. Serial histologic sections are necessary, therefore, to study accurately the morphologic features of the root canal system. Much information on this anatomic relationship originates, however, from studies of the permanent dentition. The documentation of accessory canals in furcation areas of primary molars is scanty and the reports are contradictory.

The aim of this study was to investigate the existence of patent accessory canals in the furcation areas of human primary second molars, utilizing histologic sectioning and light microscopy.

METHODS AND MATERIALS

Forty human primary second molars (twenty maxillary and twenty mandibular) without any signs of resorptions were used in this investigation. The teeth had to be extracted because of extensive caries. Immediately after extraction the teeth were fixed in 5 percent formalin. Caries was completely excavated. Subsequently the pulp chamber of each tooth was exposed via occlusal opening, and pulpal remnants were removed. Teeth were radectomized and furcations were separated by using a high speed rotary instrument with a profuse water spray (Figure 1). The severed pulp chamber floors were decalcified in 20 percent hydrochloric acid. Following complete decalcification, the specimens were washed for six hours in running tap water. After decalcification the pulp chamber floors were dehydrated through ascending grades (70-99 percent) of ethanol, and cleared in benzene. Paraffin embedding followed and cross-cut serial sections (7 μm) were taken from the specimens. The serial sections of each specimen were stained with Azan. The number of sections varied from 28-130, depending on the thickness of the different furcations. The total number of the investigated sections was 2764. Light microscopic examination of each section followed at 32× magnification. Channels were classified as an accessory canal if in several sections continuity between the pulp chamber and the periodontal ligament could be observed.

RESULTS

Maxillary primary second molars

Accessory foramina were present in the furcation of sixteen of twenty teeth (80 percent). In all cases of accessory

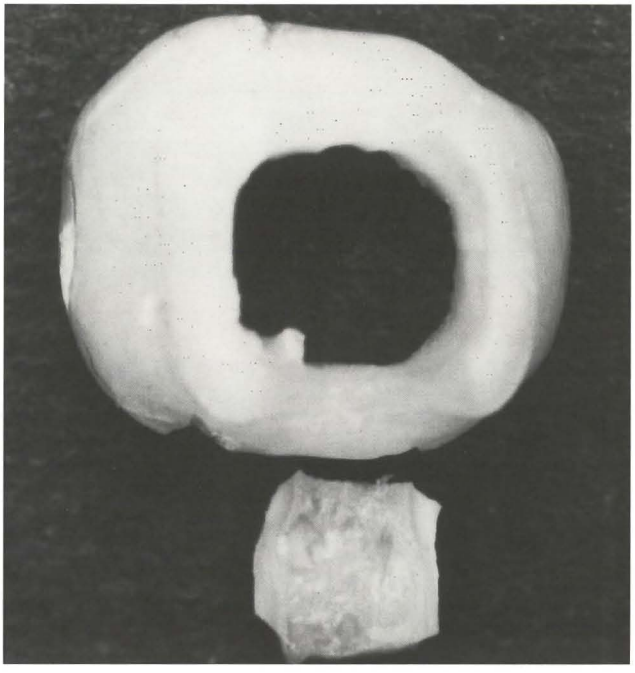

Figure 1. Separated furcation of a primary second molar.

orifices found in the furcation area, we generally observed more than one (maximum = 15) in the respective primary second molars. The total number of furcation foramina, found in the furcation regions of the maxillary primary second molars, was sixty-four. A total of thirteen accessory foramina (with a maximum of four) was found in the pulpal floors of seven specimens (35 percent). In four specimens (20 percent) no accessory foramina were evident. A typical accessory canal first appeared as an indentation in the cementum. In the upper sections the indentation became more prominent, coursed the dentine and reached the pulp chamber floor. Nine accessory canals (from one to two per furcation) were found in six (30 percent) maxillary primary second molar furcations.

Mandibular primary second molars

In fifteen of twenty (75 percent) mandibular primary second molar furcations, seventy-five accessory foramina (maximum = 26 for the respective specimen) were found. In the pulpal floors, up to three accessory foramina could be observed in eleven primary second molars (55 percent), whereas the total number of foramina was fifteen. Two teeth (10 percent) did not reveal any accessory orifices. Six teeth (30 percent) demonstrated eight accessory canals, running from the pulp chamber to the periodontal ligament.

Table ☐ Maxillary and mandibular primary second molars demonstrating accessory foramina and canals.

	Orifices in: furcation area	Orifices in: pulp chamber floor	Patent canals
Maxillary primary second molars	16/20 (80.0%)	7/20 (35.0%)	6/20 (30.0%)
Mandibular primary second molars	15/20 (75.0%)	11/20 (55.0%)	6/20 (30.0%)
Total	31/40 (77.5%)	18/40 (45.0%)	12/40 (30.0%)

Figure 2. Histologic section: Accessory foramina in the furcation area.

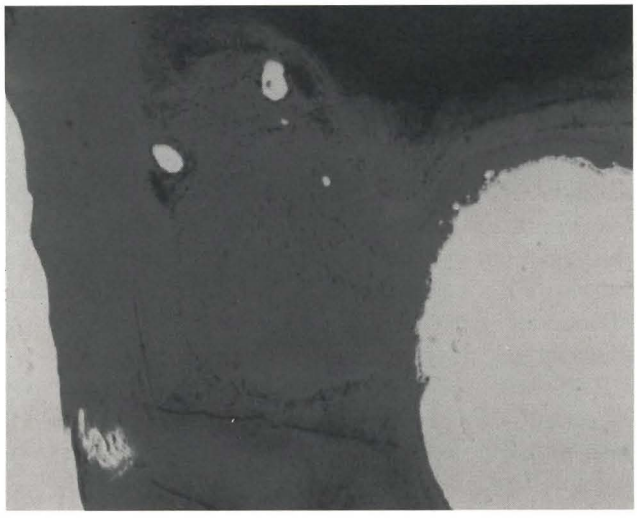

Figure 3. Histologic section: Accessory foramina in the pulp chamber floor.

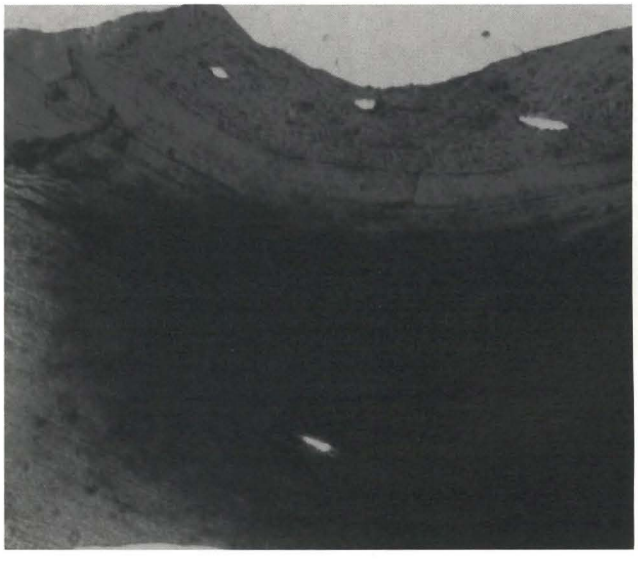

Figure 4. Histologic section: Accessory canals connecting the periodontal ligament and the pulp chamber.

Maxillary and mandibular primary second molars

The results are presented in the table. Thirty-one of forty (77.5 percent) of the examined specimens demonstrated accessory foramina in the furcation area (Figure 2). Accessory foramina in the pulp chamber floor were seen in eighteen of forty (45 percent) of the primary second molars (Figure 3). Twelve teeth (30 percent) had accessory canals, connecting the periodontal ligament with the pulp chamber floor (Figure 4). Six teeth (15 percent) had no accessory orifices in the pulp chamber floor and in the furcation area (Figure 5). Seventeen and three tenths percent of the accessory foramina were found in the pulp chamber floor and 82.7 percent were observed interradicular close to the periodontal ligament.

DISCUSSION

An accessory canal is defined as a passage from the main root canal system to the periodontium.[19] Any study of the complex root canal system of human teeth is probably inaccurate without serial sectioning. Histologic investigations, however, present a few disadvantages. Some sections might get lost by sectioning and staining. On the other hand large numbers of sections are obtained, because of the average thickness of 7 μm per section. Simpson did not find any accessory canals in the furcation regions of 150 primary teeth.[10] Two different materials, tinted silicone elastomer and epoxy resin were injected. Accessory canals entering the pulp chamber in the region

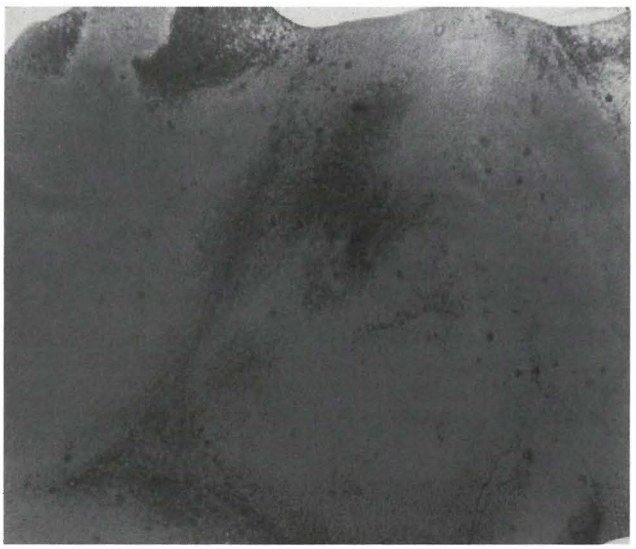

Figure 5. Histologic section: Pulp chamber floor without accessory canals.

of the furcation are smooth walled with a 5 to 7 μm diameter.[7] Thus it might be supposed that the materials could not flow to reach the smooth-walled canals. Histologic examinations of pulpal floors of primary molars demonstrated that 20 percent of the primary molars had accessory canals, running from the pulp chamber floor to the periodontal ligament. The molars were sectioned serially at 15 μm and examined for accessory canals.[7] These results are approximately in accordance with the results of our study: 30 percent of the primary second molars demonstrated accessory canals. In contrast to this investigation, we only examined primary second molars and our results indicate a slightly higher incidence of accessory canals in primary second molars than in primary first molars.

The presence of a great number of accessory orifices in the furcation areas, without passage into the pulp chambers, of permanent molars, does not correlate with the frequency of periodontal disease in this area originating from necrotic pulps.[15,16,20-22] An investigation of 100 subacute or chronically abscessed primary molars showed that 23 percent possessed accessory canals leading to the interradicular root surface.[11] Violet methyl dye was injected into the pulp chambers with a vacuum pump. Radiographic examination demonstrated generalized interradicular rarefaction. Six percent of the teeth had areas of resorption that might have originated from former accessory canals. The number of accessory orifices with one end closed was not recorded.

The internal and external furcation areas of twenty human primary molars was investigated by scanning electron microscopy.[8] Twenty percent of the sectioned furcation areas examined by SEM on the internal furcation surface and 50 percent of the external furcation areas demonstrated accessory foramina. Topographical SEM studies of the presence of accessory foramina in the furcation areas of primary molars provide detailed examination of these hard tissue surfaces because of the high magnification. SEM investigation reveals, however, only accessory foramina. The nature of a canal (true canal, canal with end closed, enclosed canal, and looping canal) cannot be evaluated.[12] The present light microscopic study of the furcations of primary second molars demonstrated accessory foramina in the pulpal floors in 45 percent of the specimens and in 77.5 percent of the external furcation areas.

In another study twenty primary molars were perfused with low viscosity latex, using positive (ten specimens) and negative (ten specimens) vacuum pressure to demonstrate accessory canals, subsequently followed by light microscopic examination. None of the ten primary molars, perfused under positive pressure, demonstrated accessory canals, and one of ten molars was found to have one accessory canal, when negative vacuum pressure was used.[9] The frequency of accessory canals evidenced by latex perfusion studies was in contrast to the results obtained in histological studies by Moss, who found accessory canals in 20 percent of the specimens.[7] In addition, Yoshida reported a frequency of 75 percent accessory canals (true, one end closed, enclosed, and looping canals).[12] Ten percent of the first mandibular primary molars showed accessory canals connecting the pulp chambers and the periodontium. This is in contrast to our findings, which showed that 30 percent of the primary second molars had accessory canals.

Inflammation of the periodontal ligament may originate from inflamed and necrotic pulps via lateral canals and accessory canals in the furcation region of molars. The presence of accessory canals does not necessarily imply a relationship between pulp and periodontal disease.[3] An examination of the pulpal floors of fifty-six infected primary molars suggested that since accessory canals were not present in all infected primary molars, they could not be considered the sole reason for interradicular radiolucency.[7] In a study of abscess formation in connection with primary molars, it was postulated that in at least 29 percent of primary molars, the site of radiographic change and clinical abscess formation may be accounted for by accessory canals between the pulp and the interradicular tissues.[11] Transport of infected mate-

rial and toxin may be possible via the furcation canals through the interradicular periodontal ligament, thus causing bone morbidity.

CONCLUSIONS

Based on the methodology and on the results of this study, two major conclusions can be drawn:

- ☐ Serial histologic sections are necessary to study the morphology of the complex root canal system of human teeth.
- ☐ Accessory furcation canals might be responsible for interradicular bone alterations of primary molars in case of pulpal inflammation or necrosis.

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DIAGNOSTIC TOOLS AND MEASUREMENTS

It may be necessary to re-establish effective communications between clinicians and researchers in order to create a virtuous circle in which clinicians participate in setting the agenda for research by helping to define priorities. Involvement in the research process should render the practitioners more receptive to the adoption of any recommendations which flow from the results of such studies, while evaluation of any changes in clinical practice could then establish whether oral health had, in fact, been improved.

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How does the use of different sugar products predict caries in 18-year-old Finns?

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Arja Rimpelä, MD, MSc, PhD

In Finland most of the child population is caries-free or nearly so; while for a minority, caries experience still remains relatively high.[1,2] Adolescence in particular is a time of considerable caries activity and risk.[3] While the prevention of caries is based on a healthful oral regimen (e.g. frequent toothbrushing with fluoride toothpaste, restricted use of sugar products), it is very important to assess the risk of caries due to misuse of such items. Use of sugar products is the major factor studied in the assessment of risk for dental caries.[4,5]

The importance of diet and its effect on dental disease is well known, and sucrose has been shown to be the most important dietary factor in the etiology of caries.[6,7] The frequency of using sweets and other sugary products tends to be the primary etiologic factor in dental caries.[8] Among adolescents a positive correlation has been shown between caries experience and consumption of sugar in different countries.[3,9,10] There have been few longitudinal studies among adolescents, however, concerning consumption of sugar and caries exposure. The follow-up time in those studies has varied from one to four years, and the association between clinically observed caries experience and use of sugar-containing products has been clear.[11-15] Although the relationship between sucrose and caries has been clearly established, the value of self-reported dietary habits for predicting caries without clinical dental examination is still unclear.[2]

The aim of this study was to ascertain whether self-reported use of sweets, cakes, sugar-sweetened coffee and sugar-sweetened tea at the ages of twelve, fourteen, and sixteen could predict the number of caries lesions (self-reported but previously diagnosed by a dentist) of eighteen-year-old Finns.

MATERIALS AND METHODS

The data for this study were collected as part of the nation-wide research program, the Adolescent Health and Lifestyle Survey, which started in 1977.[16] Since then, questionnaires were sent in February every other year to a representative sample of twelve-, fourteen-, sixteen- and eighteen-year-old Finns throughout the country. All adolescents born in 1968 and having their birthdays on 20–25th July formed the sample of the present study (N = 1106). This sample was derived from the Population Register Centre of Finland. The 1981 survey (adolescents at the age of twelve) was the baseline, and follow-ups were sent in February 1983 (when these adolescents were fourteen), in 1985 (when they were sixteen) and in 1987 (when they were eighteen). Using the same criteria, the sample was redrawn from the population registry in each survey and the questionnaire was mailed to the whole sample independently of the previous response status. All four questionnaires were returned by 62 percent of the sample. The response rate was higher among

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girls than among boys. Sample and response rate are presented in Table 1.

The questions on use of different sugar products were structured and, in order to guarantee comparability, were identical on all questionnaires. To the questions "How often do you eat sweets?" and "How often do you eat cakes?" five alternatives were given: *several times a day, about once a day, about 3-4 times a week, about once a week or seldom*, and *never*. In the analyses the answers were recoded into two classes: daily and not-daily. To the questions "Do you use sugar in your coffee or tea?" and "How many lumps or teaspoons of sugar do you add?" five alternatives were given: *not at all, one, two, three or more, I do not drink coffee/tea daily*. In the analyses the answers were recoded: drinking daily and using sugar, and not drinking daily or not using sugar in coffee/tea. To the questions concerning use of sugar-products, the proportion of nonrespondents was 0 percent to 2 percent.

In 1987, when they were eighteen, the adolescents were asked in a structured question, the number of caries lesions in the previous dental examination: "If you have visited a dentist during the previous two years, was caries detected in your teeth?" Three options were given: *no caries, one lesion,* and *several lesions*. The number of lesions was considered to be an estimate of caries incidence. In the analyses the answers were recoded: 0 to 1 lesion and several lesions (high-risk group). Among those who returned all four questionnaires (676), eighty-four (12 percent) adolescents had not visited a dentist during the previous two years. Those adolescents were excluded from the analyses. This proportion was higher among boys (18 percent) than among girls (8 percent).

The chi-square test in bivariate analyses and a logistic regression model were applied to test the associations of sugar products used with detected caries lesions. In the bivariate analyses, the data were cross-tabulated and a logistic regression model was used to estimate the probability that an event will occur. The odd ratios (OR) were used to compare the relative risk of sugar products for the number of caries lesions. Boys and girls were analyzed separately, in different age-groups. The 95 percent confidence limits (95 percent CI) were calculated according to the formula: 95 percent CI = $e^{B \pm 1.96 S.E.}$. The possible interactions between the daily use of different sugar products and caries incidence were also analyzed by the logistic regression model. To determine the possible cumulative caries effect, caries incidence was compared with consistent use of sugar products and was tested both by the chi-square test and by the logistic regression model. These analyses included those adolescents who had remained in the same behavioral group in the different follow-ups.

RESULTS

About 27 percent of both the boys and the girls had several caries lesions. The proportions of adolescents using different sugar products daily are presented in Table 2. Daily use of sugar-sweetened coffee was the most common sugar product used by boys and sugar-sweetened tea was the sugar product used most by girls. Among twelve-year-olds, however, the sugar product most commonly consumed daily was cake. The daily consumption of cakes seemed to decrease with age among girls, and the daily use of sugar-sweetened coffee increased with age, especially among boys. Furthermore, boys consumed cakes and sugar-sweetened coffee more often than girls did.

Bivariate analyses

As shown in Table 3, among boys, daily use of sweets and daily use of sugar-sweetened coffee at the ages of twelve and fourteen and daily use of sugar-sweetened tea at the age of twelve were strong predictors of caries (ORτ2; Table 3). Among girls, no sugar products predicted caries. In general, among boys, the odds ratio tended to decline from the ages of twelve to sixteen, but for girls the figures appeared to remain stable.

Table 1 ☐ Sample and response rate (%) in all four questionnaires: 1981, 1983, 1985 and 1987.

		Sample size (N)			Response rate %		
Year and age	Sample	Total	Boys	Girls	Total	Boys	Girls
1981, 12.6 years 1983, 14.6 years 1985, 16.6 years 1987, 18.6 years	All those born on 20 – 25 July, 1968	1105	547	558	62	55	70

Table 2 □ Proportion (%) of adolescents using different sugar products daily, according to age and sex.

	12 years	14 years	16 years	18 years
Boys				
Sweets	22	26	22	24
Cakes	42	39	45	43
Daily use of sugar	39	41	47	53
Daily use of tea	38	37	36	32
Girls				
Sweets	20	27	27	26
Cakes	40	34	32	28
Daily use of sugar	28	30	34	30
Daily use of tea	38	42	35	34

Table 3 □ Associations (Odds Ratios, p-values) between the daily use of different sugar products at the ages of 12, 14 and 16, and caries incidence at the age of 18, according to age and sex (bivariate analyses).

	12 years		14 years		16 years	
	OR	p-value	OR	p-value	OR	p-value
Boys						
Sweets	2.3	0.009**	2.2	0.009**	1.1	0.854
Cakes	1.3	0.428	1.4	0.280	1.6	0.115
Coffee with sugar	2.4	0.002**	2.2	0.010*	1.6	0.091
Tea with sugar	2.2	0.008**	1.7	0.079	1.1	0.811
Girls						
Sweets	1.1	0.789	0.9	0.672	1.4	0.195
Cakes	1.2	0.422	1.0	0.812	1.3	0.292
Coffee with sugar	1.1	0.707	1.2	0.369	1.2	0.484
Tea with sugar	0.9	0.505	0.7	0.110	0.9	0.861

*p < 0.01
**p < 0.05

Table 4 □ Associations (Odds Ratios, 95% CI) between the daily use of different sugar products at the ages of 12, 14 and 16, and caries incidence at the age of 18, according to the study year and sex (logistic regression analyses).

	12 years		14 years		16 years	
	OR	95% CI	OR	95% CI	OR	95% CI
Boys						
Sweets	2.0	0.99–3.87	2.2	1.13–4.12	0.9	0.53–2.12
Cakes	1.0	0.70–1.91	1.2	0.62–2.17	1.4	0.79–2.62
Coffee with sugar	2.5	1.35–4.63	2.2	1.20–4.05	1.6	0.89–2.96
Tea with sugar	2.1	1.15–3.91	1.8	0.96–3.27	1.2	0.66–2.26
Girls						
Sweets	1.0	0.57–1.88	0.9	0.64–1.90	1.5	0.88–2.57
Cakes	1.2	0.72–1.93	0.9	0.69–1.94	1.1	0.62–1.80
Coffee with sugar	1.1	0.64–1.89	1.3	0.76–2.13	1.2	0.68–1.96
Tea with sugar	0.8	0.72–1.93	0.7	0.88–2.37	0.9	0.67–1.88

Logistic regression analyses

Among boys, the frequency of using sugar-sweetened coffee was consistently associated with caries incidence at the ages of twelve and fourteen among boys (OR≥2; Table 4). The association was stronger at the age of twelve than at the age of fourteen. Daily use of sweets at the age of fourteen and daily use of sugar-sweetened tea at the age of twelve were also significant predictors for caries among boys. Among girls, however, for no sugar product was the daily use associated with caries incidence.

When the possible interactions between different sugar products were studied, the only significant interaction was found among twelve-year-old boys and among sixteen-year-old girls. Among twelve-year-old boys, sugar-sweetened coffee in interaction with cakes had quite a strong power to predict caries incidence (OR=4.4, p=0.0006). Among sixteen-year-old girls, an interaction between sugar-sweetened coffee and sweets increased the power of sweets consumption to predict caries to a significant level (OR=2.1, p=0.028).

Analysis of cumulative effect

When the associations between caries incidence and consistent daily use of different products were analyzed, the only significant association was with consistent use of sugar-sweetened coffee (OR=3.4, p=0.023) among boys. Those boys who had been consuming sugar-sweetened coffee consistently on a daily basis every year more frequently (46 percent) had several caries lesions as opposed to those who had never used sugar in coffee daily (20 percent). Boys who had consumed sugar-sweetened coffee daily in all four surveys had a more than three times higher risk for caries than those who had not consistently consumed sugar-sweetened coffee daily (OR=3.3, p=0.013). Those boys who reported eating sweets in all four surveys had a three times higher risk for high caries incidence than nondaily consumers of sweets had (OR=3.3, p=n.s.). Among girls, no significant predictors for caries were detected according to consistency of consumption of any sugar product studied.

DISCUSSION

The main goal of this study design was to determine whether the caries risk of eighteen-year-olds could be predicted by using questionnaires retrospectively over a six-year period. This kind of longitudinal study has not been made for the same adolescents over this long a period. Studies aimed at predicting caries have, in general, not been very successful.[17] Usually in cross-sectional questionnaires the use of different sugar products has been checked only once. In this study, on the other hand, information about the use of sugar products was collected by four different questionnaires, which together were expected to give more reliable estimates of

the actual behavior. By the end of the study, however, it was no longer nationally representative, because the rates of nonparticipation increased as new questionnaires were sent. The figures for consumption of different sugar products on a daily basis seemed to be in agreement with the results of previous Finnish studies.[18,19] Among the adolescents in this sample, the daily use of sugar-sweetened coffee and cakes has been declining gradually, and daily use of sweets has increased slightly from 1977 to 1989.[18,19] The validity of using a questionnaire to measure frequency of food intake has been studied earlier and found to be reliable. Snacks and desserts were found to be estimated accurately.[20] In the present study the frequency of consuming different sugar products was recoded into daily and nondaily groups, because daily use of any sugar product could be considered a risk factor for caries. Simultaneous use of several sugar products was also analyzed as accumulated caries risk.

The other new aspect of this study design was the estimation of caries incidence by questionnaire; in previous studies this has always been based on clinical examinations. The self-reported caries incidence was only a rough measure, because it was collected as a categorized variable. Adolescents with several caries lesions were considered to belong to the high caries-risk group, because those with only one lesion might have had that lesion for some other reason than caries. It was also assumed that it would have been quite easy for adolescents to remember whether they had no, one or several caries lesions at the previous dental check-up. While in Finland annual dental check-ups include almost the whole population in these age-groups, it would be expected that there would be no great bias due to variation in the treatment intervals. When percentages of adolescents with several caries lesions have been used as a measure for determining the high-risk group, this has been shown to be quite a good predictor of caries incidence.[21] The proportion of adolescents who had not visited a dentist during the last two years was very low, only twelve percent. The proportions of adolescents with several caries lesions were small (27 percent), but were high enough for assessment of the high-risk group.

Nonrespondents were analyzed by comparing the dental health behavior of those adolescents who answered all four questionnaires and those who answered only two consecutive questionnaires (with lower rates of nonrespondents). There were only small and inconsistent differences between these two groups, which justifies the assumption that the behavior of nonrespondents does not differ significantly from that of respondents.

The repeatability of the questions concerning dental health behavior, when analyzed separately in 1993 by two questionnaires sent at an interval of one month to 409 sixteen-year-olds, was quite high. Although there are evidently some random errors in the answers, the repeatability and kappa-values in these two consecutive questionnaires were satisfactory. Random errors make the estimates of dental health behavior lower than they really are.

According to this and some other studies, boys consumed more sugar products than girls did.[19,22-24] Due to the fact that boys and girls used sugar products differently, the data in this study were analyzed separately. The main finding was the positive association between daily use of sugar-sweetened coffee at the ages of twelve and fourteen and caries experience of eighteen-year-old boys. For boys, daily use of sweets at the age of fourteen was also quite an important predictor of caries incidence. These findings differ, however, from those of previous studies. Rugg-Gunn *et al* found that the correlations between caries increment and all sugar-sweetened drinks were lower than the correlations between caries increment and sweets, biscuits, cakes and puddings.[7] In another study when caries risk was assessed in a clinical trial, consumption of sweets clearly ranked first and other sugar products (not specified) second.[8] In Finland, however, the use of sugar-sweetened coffee is relatively high; every second Finnish boy and every third girl drank sugar-sweetened coffee daily. On the other hand, in most European countries approximately half of the children consume sweets regularly.[25]

CONCLUSIONS

The bivariate and multivariate analyses gave almost identical results. In addition to sugar-sweetened coffee, daily use of sugar-sweetened tea and daily use of sweets among twelve-year-old boys and daily use of sweets among fourteen-year-old boys were more significant predictors by the chi-square test than by the logistic regression model. This confirms that each sugar product seems to affect caries independently. Among boys, the most common predictor, daily use of sugar-sweetened coffee, was an important predictor, although the risk was quite low. Among girls, no predictors were found.

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PAIN CONTROL

Our knowledge of the mechanisms of pain has increased exponentially in the last two decades. We have learned that accepted and well-proven methods of pain relief, such as local anesthetics and non-steroidal anti-inflammatory drugs, can reduce pain by decreasing the neural barrage that enters the central nervous system following injury. Our knowledge about the changes in the chemistry of the brain produced by tissue or nerve injury is leading to the evaluation of new pharmacological approaches to the management of pain. Physical therapies and behavioral and cognitive approaches are proving to be useful in the treatment of chronic pain and its debilitating sequelae.

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An in vitro caries inhibition of photopolymerized glass ionomer liners

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Cory Ingram

Secondary caries, one of the major causes for replacement of amalgam and composite restorations, is located at the interface between the restoration and tooth structure.[1-5] Development of an ideal restorative material, that provides a permanent seal with tooth structure, has been thwarted by complicating factors present in the oral environment: changes in intraoral temperature (thermal expansion), solubility of certain restorative materials in saliva, and change in pH.[6-13] Consequently, increased emphasis has been placed on developing restorative materials with anticariogenic properties.

Fluoride has demonstrated anticariogenic effects, and this beneficial effect on the human dentition has led to the examination of available fluoride in a host of dental materials.[14-28] Glass ionomer cements have the capability of leaching fluoride, which occurs naturally by association with the glass incorporated into the cement.[22,24] Data are available verifying that the leached fluoride is, in part, subsequently taken up by tooth structure.[22,29,30] Several investigations have demonstrated the occurrence of an inhibition zone adjacent to restorations containing glass ionomer cement; whereas, control restorations containing no glass ionomer cement had no inhibition zones and often even demonstrated carious wall lesions.[31,32]

Resins have been developed for use in contemporary restorative dentistry. Due to the concern for secondary caries inhibition, manufacturers have added fluoride to resins to encourage a decrease in adjacent tooth demineralization. The addition of fluoride to resins has conflicting results regarding caries inhibition. The development of a photocured glass ionomer liner has shown its effectiveness in caries inhibition.[31,33-35] The purpose of this study was to evaluate the caries inhibition of a new photopolymerized glass ionomer liner, comparing it to an available photopolymerized glass ionomer liner that has established caries inhibition.

METHODS AND MATERIALS

Thirty extracted human permanent molars, which had been stored in sterile saline solution with 0.1 percent thymol, were used in this study. The teeth were cleaned with pumice and examined to determine that each was caries-free. Class V preparations were made on the mesial and distal surfaces of each tooth at the cervical junction. The preparations extended 2 mm axially, 4 mm occlusogingivally, and 5 mm buccolingually. Each preparation had a 90 degree gingival cavosurface margin below the cementoenamel junction and 0.5 mm beveled occlusal cavosurface margin in enamel.

Vitrebond®[a], Photac®-Bond[b], and Pertac® Universal Bond[c], were randomly placed as liners in equal numbers of teeth; then Pertac® Hybrid[d] composite resin was placed to complete the restorations according to manufacturer's instructions. The restoration placement was randomized so that equal numbers of each type of res-

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[a]Vitrebond® - 3M Dental Products, St. Paul, MN

[b]Photac®-Bond - ESPE Premier Dental Products, Norristown, PA

[c]Pertac® Universal Bond - ESPE Premier Dental Products, Norristown, PA

[d]Pertac®-Hybrid - ESPE Premier Dental Products, Norristown, PA

Table ☐ Mean root lesion areas adjacent to gingival restoration margins.

Group	Lesion Area (± S.D.) at 100 μm
Vitrebond®	47.2 ± 37.2
Photac® Bond	66.1 ± 27.8
Pertac® Universal Bond	120.9 ± 66.0

toration were opposing each other in the same teeth respectively. The liners covered all exposed dentin and were carried to the cavosurface margin, where no enamel was present. All restorations were polished with Sof-Lex®[e] discs, taking special care to remove any excess of restorative material on the root surface.

All thirty teeth were coated with an acid resistant varnish, leaving a minimum of 2 mm exposed adjacent to restoration margins. The teeth were then subjected to an artificial caries challenge of a demineralization solution (pH 4.4) for five days.[36] These teeth were then rinsed and stored in DDH20 until they could be sectioned. Axial sections of 100 μm were cut longitudinally through the restored area of the tooth, photographed under polarized light microscopy (×10), and the demineralized areas adjacent to the gingival restoration margin were quantitated with the use of a digitizer at ten times magnification. Data were analyzed with an analysis of variance (ANOVA) and a Duncan's multiple range test.

RESULTS

Results demonstrated the mean (± S.D.) area (μm^2) demineralization 100 μm from the restoration gingival margin to be: Vitrebond® 47.2 ± 37.2; Photac® Bond 66.1 ± 27.8; Pertac® Universal Bond 120.9 ± 66.0 (Table). An analysis of variance indicated significant differences between groups ($p < 0.002$). Duncan's multiple range test indicated there was no statistically significant difference in demineralization inhibition between Vitrebond® and Photac® Bond, yet both these photopolymerized glass ionomer preparations demonstrated significantly less demineralization than the Pertac® Universal Bond control ($p < 0.05$). Figures 1-3 show representative examples of each group respectively.

DISCUSSION

The results of this study demonstrate the caries inhibition effectiveness of Photac® Bond, as well as confirming the caries inhibition effects of Vitrebond®. There was no statistically significant difference in caries inhibition for these two photocured glass ionomer liners.

These findings are encouraging to the utilization of the photocured glass ionomer liners. They have excellent handling qualities, and due to their photopolymerization setting mechanism, can be placed and cured immediately. The light curing also decreases clinical material placement time, making the procedure very time efficient. Specifically, chemical cured glass ionomer ce-

[e]Sof-Lex® - 3M Dental Products, St. Paul, MN

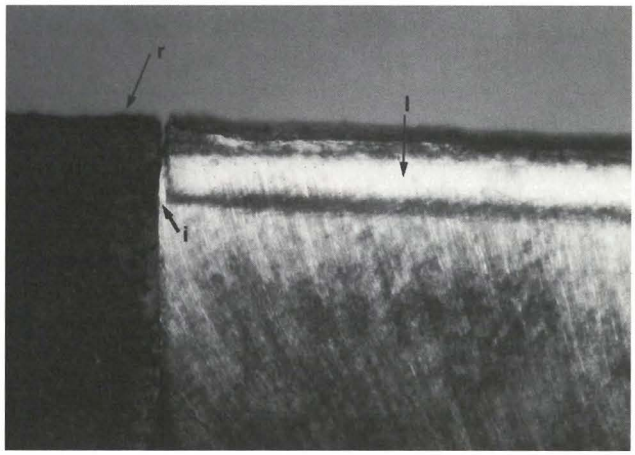

Figure 1. A polarized light photomicrograph (×10) of an artificial root lesion (l) cervical to a restoration (r) with Vitrebond® glass ionomer liner in water imbibition. Note the inhibition zone (i) adjacent to the restoration.

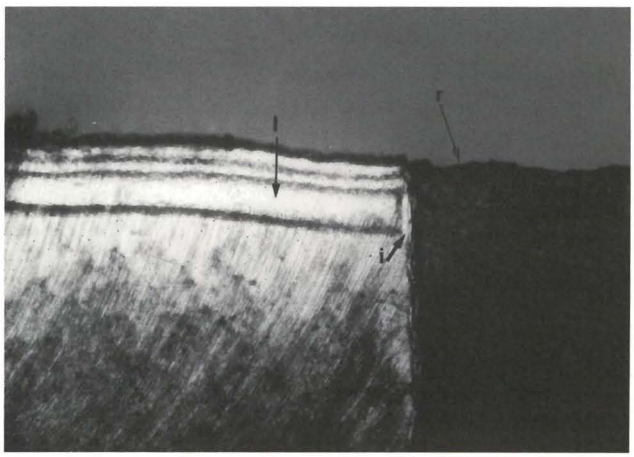

Figure 2. A polarized light photomicrograph (×10) of an artificial root lesion (l) cervical to a restoration (r) with Photac® Bond glass ionomer liner in water imbibition. Note the inhibition zone (i) adjacent to the restoration.

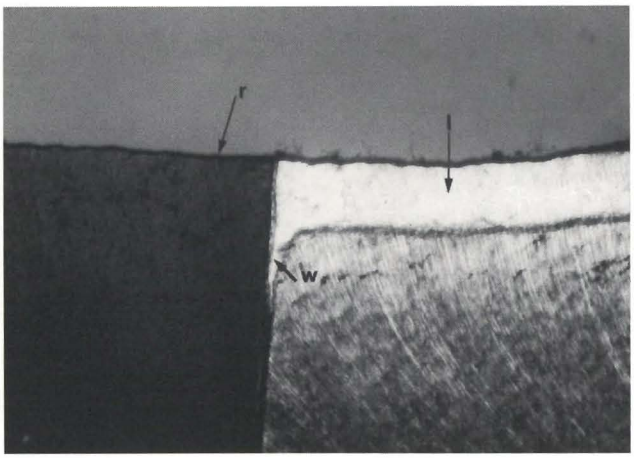

Figure 3. A polarized light photomicrograph (×10) of an artificial root lesion (1) cervical to a restoration (r) with Pertac® Universal Bond in water imbibition. Note the wall lesion (w) adjacent to the restoration.

ments take approximately five minutes to set compared to twenty to forty seconds for the photocured glass ionomers. The bonding potential of the resin matrix provides a material with better bond strength to tooth structure, thereby reinforcing the prepared tooth during the restorative process.

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Resin-modified glass ionomer cements (RM GICs): Implications for use in pediatric dentistry

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The quest for the ideal restorative material is an ongoing challenge. The introduction of glass ionomers in 1972 and Dr. Bowen's invention of composite resins ten years earlier served to revolutionize the field of modern day dentistry.[1]* The poor wear characteristics, esthetics and long setting reaction of the glass ionomers have been modified to a considerable extent with the newer materials showing comparable strength, esthetics, and wear characteristics to the composite resin materials. Its advantage for use in the child patient has been well documented both from an esthetic and preventive standpoint.[2-5]

The newest entrant into the restorative arena is the "Resin-Modified Glass Ionomer Cement" (RM GIC).[6] Resin Ionomers, Resin Reinforced Cements, Hybrid Ionomer, are some of the several terms used to describe these materials. The nomenclature that perhaps best describes them, however, is the term "COMPOMER" (Figure 1). These new glass ionomer cements are superior to the previous generations in terms of their decreased sensitivity to moisture and superior bond strength.[6,7] Their enhanced esthetics, ease of placement, and light curing polymerization make them an attractive alternative for use in the child patient. The purpose of this article is to highlight the current status of resin-modified glass ionomer materials and describe the clinical procedure for application of one such commercially available product.

LITERATURE REVIEW

The resin modified cements are predominantly glass ionomer, up to 80 percent, with 20 percent being light-cured resin.[8] Glass ionomers set by an acid-base reaction between the ion leachable glass powder and polyacrylic acid resulting in a sol-gel transformation.[6,9] In the newer resin modified glass ionomer cements, the water component is substituted with a resin such as hydroxyethyl methacrylate (HEMA) or Bis-GMA.[6,10] In addition these materials contain small quantities of photoinitiators and stabilizers. Being a combination of two chemically different materials, their setting characteristics also are different. Although there does not seem to be a consensus on this topic, the initial reaction appears to be an acid-base interaction followed by photochemical polymerization of the matrix when subjected to light curing.[6] Some investigators believe that the light exposure only precipitates an initial set and that there is a post-cure period that lasts typically for 24 hours.[9] While a few of these materials are considered dual-cure, materials such as Fuji II LC**(GC Corporation, Tokyo, Japan), Vitremer^^ (3M Dental products, St. Paul, MN, USA), that have a tri-cure polymerization reaction. So a true clas-

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*Bowen, R.L.: Dental filling material comprising vinyl silane treated fused silica and a binder consisting of a reaction product of bisphenol and glycidyl acrylate. U.S. patent:3,006. 112, November 1962.

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1. Resin Ionomers°
2. Resin Modified Glass Ionomer Cements (RM GICs)°
3. Hybrid Ionomers°
4. Resiomers°
5. Polymer Reinforced Glass Ionomers°
6. Fluoride Releasing Cements°
7. Compomers = COMPOsite + Glass IonoMER

1-6° - Glass Ionomers: The Next Generation. Proc. 2nd Int. Symp. Glass Ionomer. Hunt PR, ed., Philadelphia, 1994.

Figure 1. Some terms used to describe reinforced glass ionomer cements.

Table ☐ Commercially available brands of resin modified glass ionomers.

Brand	Manufacturer	Curing Reaction
Fuji II LC	GC Corporation, Tokyo	Dual
Vitremer Cement	3M Dental Products, MN	Tri
VariGlass	LD Caulk, Milford, DE	Dual
Dyract	De Trey, Konstanz, Germany	Dual
Compoglass	Ivoclar/Vivadent, Amherst, NY	Single

sification for the nomenclature of these materials is yet to be reached.

Though relatively new to the arena of restorative materials, information and research on resin modified glass ionomers and compomers is slowly gathering momentum and studies are continuing to test these materials in an *in vivo* environment. Some *in vitro* studies have shown the "compomers" to possess superior compressive and tensile strengths compared to conventional glass ionomers.[11,12] Peters and Roeters' study on the occlusal wear of Dyract® (Dentsply, Konstanz, Germany) in primary teeth showed minimal wear after a period of twelve months, implying its usefulness as a restorative material for class I and II lesions in primary teeth.[13] In addition the fluoride leaching property makes this material valuable for use in class II preparations with adjacent white spot lesions. Mitra showed that the fluoride release from the resin modified glass ionomers was superior to that of conventional glass ionomers.[14] Some of the newer materials are capable of sustained fluoride release over a considerable time period, up to four months in some cases.[15] Some investigators believe that the newer compomers are capable of acting as a fluoride reservoir by absorbing fluoride from the environment, such as during topical fluoride applications, and in this way recharging their fluoride supply.[16] If this is indeed true and in the light of Garcia-Godoy's observation, these materials could provide a continuous intraoral source of fluoride.

Figure 2. Compoglass™ restorative system

Compoglass™ (Ivoclar/Vivadent, Amherst, NY) recently entered the market as a restorative material for use in pediatric patients. Compoglass™ is a single paste system available in predosed plastic cartridges called Cavifils. The system (Figure 2) is easy to use and allows cavity preparations to be filled from the bottom up, thus minimizing air entrapment. The material is provided with a bonding agent Compoglass™ SCA (Single Componant Adhesive)[Ivoclar/Vivadent, Amherst, NY] which is a light-curing, enamel-dentine bonding material consisting of methacrylate-modified polyacrylic acid, HEMA, water, maleic acid, photoinitiators and stabilizers.[10]

CASE REPORT

The following section describes the technique for placement of Compoglass™ in a Class II cavity preparation. The restorative procedures were done on a patient who presented to the pediatric dentistry clinic at the University of Minnesota School of Dentistry. The patient had a radiographically detectable caries lesion on the proximal surface of his right maxillary first primary molar (Figure 3). After adequate local anesthesia was obtained, the tooth was isolated with rubber dam (Figure 4). A conservative class II preparation was made and a clear matrix inserted in the proximal space; wooden wedges were used to stabilize the matrix (Figure 5). The Compoglass™ SCA was applied to the cavity and left to cure for twenty seconds (Figure 6). A gentle stream of oil-free air was used to thin out the film of SCA. According to manufacturer's recommendation a second layer of

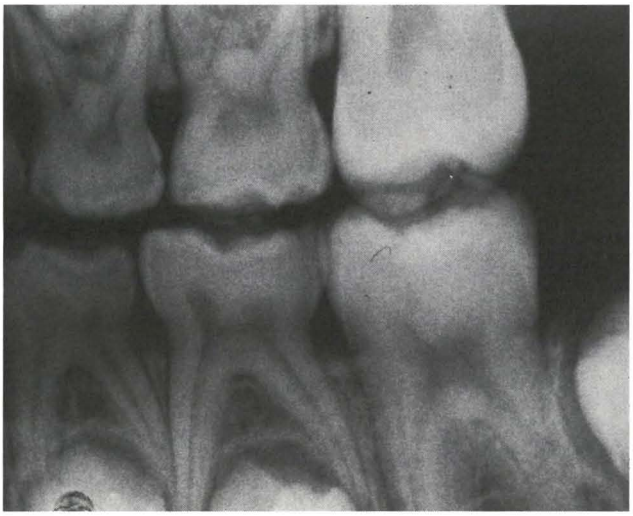

Figure 3. Preoperative bitewing radiograph.

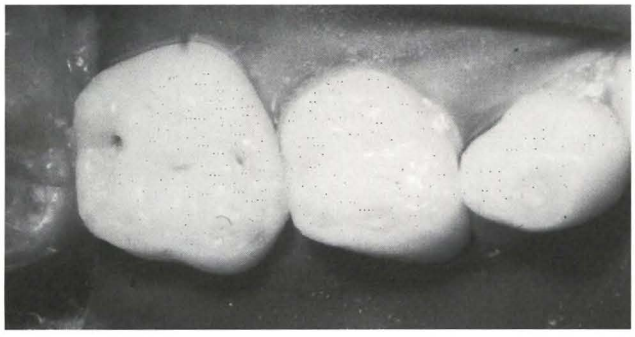

Figure 4. Rubber dam isolation of affected molar-preoperative view.

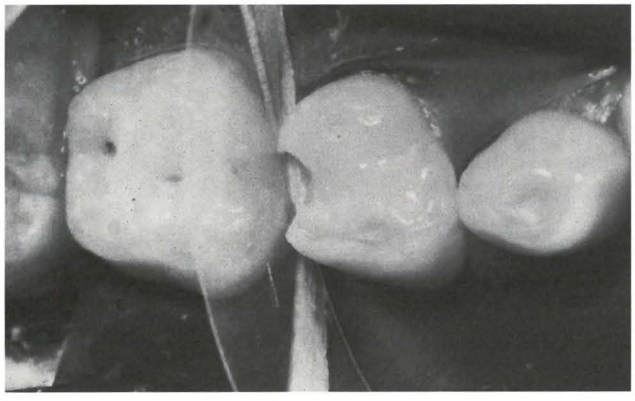

Figure 5. Class II preparation and placement of acetate matrix and wedge.

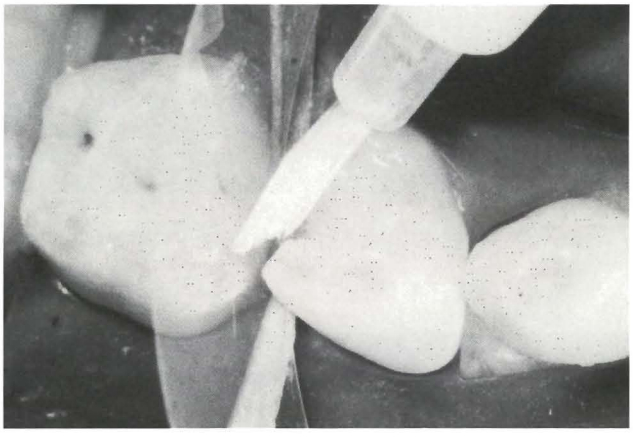

Figure 6. Placement of Compoglass™ SCA.

Figure 7. Placement of Compoglass™ restorative material.

Compoglass™ SCA was added and light cured for twenty seconds. The Compoglass™ restorative material was placed into the cavity preparation and light cured for forty seconds (Figure 7a/b). A slow speed handpiece with a #4 round bur was used to finish the restoration and remove excess material. An interproximal polishing strip, medium and fine grit, (Moyc® o Industries, Inc., Philadelphia, PA) was used to smooth and finish the proximal surface of the restoration (Figure 8). A thin film of Compoglass™ SCA was applied to the finished restoration and light cured for twenty seconds to give the surface a smooth glossy finish (Figure 9).

DISCUSSION

A simple yet effective method of restoring primary teeth is described. The material, Compoglass™ (Ivoclar/Viva-

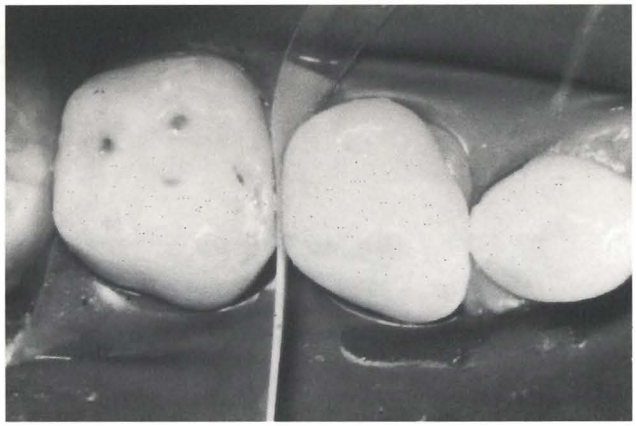

Figure 8. Finishing proximal surface with interproximal finishing strip.

Figure 9. Final restoration.

dent, Amherst, NY), is easy to use and its premixed single paste system allows rapid placement of material and saves valuable chairside time. The material differs from other compomer materials in that it is predominantly composite (70 percent) and 30 percent glass ionomer. As a result its strength is significantly enhanced but whether the fluoride releasing property is affected, is not known. In vivo studies are planned to investigate further these questions. Acid etching at the tooth surface is not required with this material since the Compoglass™ SCA is an enamel-dentine bonding agent that bonds effectively to the smear layer on the dentinal surface. The resin-reinforced, strength and fluoride releasing properties make this an excellent choice for use as a preventive restoration in the primary dentition. Perhaps the most significant feature of resin modified glass ionomer cements is the fact that they provide an attractive alternative to amalgam.

CONCLUSION

Compomers, or Resin Modified Glass Ionomer Cements (RM GICs), appear to be emerging as a useful alternative to amalgam. Their superior strength compared to conventional glass ionomer cements, ease of application, fluoride release, and esthetics are qualities that warrant use in primary teeth. The technique described above is easy to use and saves chairside time. Few reports are available regarding the use of the RM GICs in permanent teeth although clinical studies on the long-term durability of these materials are ongoing. Current studies show that resin-ionomer restorations placed in permanent teeth show increased occlusal wear, hence a certain degree of care must be exercised when using compomers in permanent teeth.[17] A Clinical Research Associates survey showed that amalgam still is the most frequently used (73 percent) restorative material for primary posterior teeth.[18] It is likely that as more practitioners use the new-age materials, better techniques and materials will evolve, leading to an overall improvement in pediatric dental care.

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DEMOGRAPHICS

Changing welfare as we know it: Some thoughts about the impact on children

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

"Effective October 1, 1996, no individual or family shall be entitled to any benefits or services' under state welfare programs financed with Federal money."[1] The new federal welfare law will abolish the federal guarantee of welfare benefits, principally Aid to Families with Dependent Children (AFDC).* States will be given block grants to use as they wish to aid the poor. These funds are not "earmarked" for specific categories within the welfare program. The total annual amount for all block grants, $16.4 billion, will remain constant until 2002, with no allowance for either inflation or population growth. Eligibility criteria and benefit levels, which already vary from state to state, could vary even more. The new law also establishes work requirements for most people seeking welfare or other benefits; states that do not meet these requirements may lose some of their federal grants.[3]

Since the Rose Garden signing of the new welfare legislation in August 1996, the news media has been rife with reports of the concerns by state and local officials that the new provisions are tougher on recipients and less flexible for states than some officials and envisioned. For example, even though forty-five states have received permission to experiment with their own welfare programs, they still will have to meet a strict standard of having a quarter of their welfare recipients working by next year or face losing some of their federal block grant funds.

While many in the general public welcome changes in the welfare system, we should not overlook the potential impact on those in our society who depend the most on welfare support programs—our country's children. Note: in 1994, 21.8 percent of children (15.3 million children less than 18 years of age) lived in poverty, compared to:

- ☐ 4.5 million (18.0 percent): 18-24 year olds.
- ☐ 9.9 million (11.9 percent): 25-44 year olds.
- ☐ 2.4 million (7.8 percent): 45-54 year olds.
- ☐ 1.1 million (10.4 percent): 55-59 year olds.
- ☐ 1.1 million (11.4 percent): 60-64 year olds.
- ☐ 3.7 million (11.7 percent): 65+ year olds.[4]

CONSEQUENCES OF THE NEW WELFARE LAW FOR CERTAIN RECIPIENTS

- ☐ Single mothers, youngest child is less than five years of age (62 percent of all AFDC families†). The mother will be exempt from work requirements, if she proves that she cannot find suitable affordable child care (see below).
- ☐ Single mother, youngest child is over five years of age (36 percent of all AFDC families†). The mother will be required to work within two years of receiving benefits, perhaps sooner. States

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*See a previous presentation in the *Journal of Dentistry for Children* for a review of the AFDC program.[2]

†1994 data. Individuals may be listed for AFDC benefits under more than one category.

generally will be required to have 25 percent of adult welfare recipients working at least 20 hours a week in 1997 and 50 percent working 30 hours a week by 2002. Mother and children will be guaranteed health coverage under Medicaid as long as they would qualify for welfare under past welfare legislation.

- ☐ Unmarried mother less than 18 years of age (40 percent of female AFDC recipients in 1993 gave birth to their first child before the age of 19).
  The mother will be required to live with an adult and attend school in order to receive benefits. She will not have to live with her parent or guardian, if she or her child is likely to suffer serious physical or emotional harm, sexual abuse or exploitation as a result of such living conditions.
- ☐ Missing father (33 percent of AFDC child recipients did not have paternity established[1]).
  A woman will be required to provide information about the father of her child as a condition of receiving welfare benefits. If she does not cooperate with state authorities, she will lose at least 25 percent of her family's welfare benefit. Under a national data base system, the federal government will help states locate the father and force him to pay child support. States may require genetic testing of the child and parent in some cases.
- ☐ Chronic welfare family.
  About half of all AFDC recipients are people who have received benefits for five years or longer. The new law sets a five year lifetime limit for aid from federal block grant funds. By 2004, between 2.5 and 3.5 million children could be affected by the time limit.
- ☐ Legal immigrant family (5 percent of AFDC recipients are legal immigrants).
  Noncitizens generally will be ineligible for 1) Supplemental Security Income (a cash assistance program with an average monthly payment of approximately $420 for the needy aged, blind and disabled) and 2) Food Stamps (all federal dollar benefits average $73 per month [$2.40 per day] per recipient). Note: 1.8 million of the 25 million Food Stamp recipients are legal immigrants. Four hundred thousand noncitizen recipients are residents of California.

There is to be $54 billion in savings over the next five years as a result of the denial of benefits. Exceptions will be made for those noncitizens who have worked for ten years in the United States. Note: The Social Security Administration, which keeps track of work histories, does not yet have a way to provide large amounts of its data to state and local officials who need the information to decide whether immigrants have worked long enough to qualify.[5,6]

According to the Congressional Budget Office, more than 500,000 immigrants are likely to lose Supplemental Security benefits, and about 900,000 are likely to lose Food Stamps. Legal immigrants represent about 5 percent of those on public aid, yet they will absorb about 40 percent of the cuts in welfare.[7]

Immigrants arriving in the future will be ineligible for most other government benefits as well. States will be allowed, but not required, to cut off cash assistance, Medicaid and social services for noncitizens now receiving such aid. In assessing an immigrant's need for assistance, the government will assume that the income and assets of an immigrant's sponsor are available to the alien.

- ☐ Low-income disabled child.
  The Supplemental Security Income (SSI) program for children will be cut over the next six years. The program currently provides eligible children up to $470 a month and, in most states, access to health care through Medicaid.
  As of December 1995, there were 965,100 disabled and 8,982 blind children receiving SSI benefits, including:
  - ☐ More than 52,000 disabled children in Florida, Ohio, and Texas.
  - ☐ More than 73,000 disabled children in California.
  - ☐ Almost 82,000 disabled children in New York.
  - ☐ More than 600 blind children in Massachusetts.
  - ☐ More than 700 blind children in Texas.
  - ☐ More than 1,800 in California (Table 1).

  Under the new welfare reform legislation, 315,000 low-income children with disabilities (approximately one third of disabled children) will lose or be denied access to benefits.
- ☐ Convicted drug abuser or drug dealer.
  If a person is convicted of a drug felony under federal or state law, they may not receive cash welfare benefits or food stamps. A state may override this ban.
- ☐ Childless nonworker.
  A person 18-50 years of age who is not raising children and not working may receive food stamps for only three months in a three year period, with three additional months, allowed, if the person gets and then loses a job. The Congressional Budget Office estimates that in an average month, one million jobless individuals who are willing to work and would take a work position if one were available will be denied Food Stamps under the new law.[3]

Table 1 ☐ Number of blind and disabled children receiving federally administered Supplemental Security Income payments by state: December 1995.[8]

	Blind	Disabled
Alabama	91	28,697
Alaska	19	939
Arizona	147	11,760
Arkansas	131	18,753
California	1,846	73,122
Colorado	70	9,711
Connecticut	79	5,526
Delaware	23	2,382
Dist. Columbia	13	2,871
Florida	311	58,290
Georgia	262	28,341
Hawaii	11	896
Idaho	29	3,656
Illinois	248	48,710
Indiana	150	19,617
Iowa	168	7,292
Kansas	55	8,387
Kentucky	147	22,873
Louisiana	220	40,301
Maine	36	2,654
Maryland	77	12,715
Massachusetts	621	15,919
Michigan	207	39,921
Minnesota	162	11,041
Mississippi	69	25,532
Missouri	124	20,764
Montana	29	2,419
Nebraska	33	4,325
Nevada	97	2,868
New Hampshire	15	1,801
New Jersey	101	21,966
New Mexico	60	6,657
New York	324	81,967
North Carolina	270	29,957
North Dakota	16	1,302
Ohio	389	52,664
Oklahoma	164	11,453
Oregon	88	6,599
Pennsylvania	283	43,884
Rhode Island	28	2,807
South Carolina	211	17,798
South Dakota	22	2,710
Tennessee	192	24,088
Texas	710	56,331
Utah	74	4,444
Vermont	15	1,434
Virginia	191	22,585
Washington	115	12,233
West Virginia	97	8,770
Wisconsin	134	22,087
Wyoming	8	1,191
Northern Mariana Islands	0	90
Total US.	8,982	965,100

OTHER TERMS AND CONSEQUENCES

The federal government no longer will protect fully impoverished childless adults, noncitizens and children whose parents refuse to get jobs or fail to get work by the prescribed deadlines.

There will be a five-year, lifetime limit on cash benefits, except for the 20 percent of the welfare cases that states may determine to have hardships, like the burden of caring for a disabled child. States can pay for more aid if they want, but the money must come from their own resources.

It is anticipated that there will be political battles as 1) big cities (e.g. Chicago, Detroit, and New York) compete with suburban and rural communities for the reduced federal block grant funds and 2) states with high immigrant populations (e.g. California, New York, and Texas) may stagger under the decreased funding for the services for the legal (and nonlegal) new immigrant populations.[9]

In the "short run," as a result of a continuing improvement in the economy and a 15 percent decrease in the number of welfare recipients from a record of 14.4 million in March 1994, most states will face an easier task to meet the requirement that in fiscal year 1997 (which began October 1, 1996) 25 percent of adults on welfare are supposed to be working (requirement increases to 50 percent in fiscal year 2002).[1] States that do not meet the work requirements of the new law face financial penalties. They may lose 5 percent of their federal welfare money in the first year, and penalties will grow in subsequent years.[10]

But because the annual funding level from federal block grants will remain unchanged through 2002, difficulties may arise 1) in states with increasing populations, or 2) if there is a downturn in the economy with increased levels of unemployment in some states or regions of the country.

Requiring adult welfare recipients to work for benefits would appear to be a reasonable and proper approach, but "(c)oncern grows that welfare recipients (will be taking away) union jobs."[11,12] The conflict between unionized government agency workers seeking to meet federal requirements for workfare may not be resolved easily.

Finally, while many aspects of the new legislation venture into the general arena of social engineering, there are specific provisions that encourage both marriage and sexual abstinence. For example,

- ☐ The federal government will pay $20 million in annual bonuses to each of five states that record the sharpest reductions in illegitimate births each year from 1999 to 2002.
- ☐ The federal government will allocate $40 million to states to teach abstinence, but nothing for other means of birth control.[3]

CHILD CARE—SPECIAL PROBLEMS FOR WELFARE RECIPIENTS

"...President Clinton...denounced the Republicans as 'tough on kids and weak on work.' ...the Republicans did

not provide enough money for child care and other services that welfare recipients need to enable them to work."[10]

Establishing work requirements for welfare recipients with children demands particular attention to the quality, economics and availability of child care programs.

"One of the greatest challenges for employed parents is finding good quality, low cost child care...Preschoolers are in the midst of forming personalities, developing cognitively, and learning social skills and child care providers can and do have a major impact..."[13]

The Bureau of the Census reported from its surveys of child car arrangements that, in 1993, there were 8.1 million families with preschoolers (9.9 million children) who needed child care while their mothers worked. Note: does not include children of unmarried fathers.[14,15‡]

Finances

Families paid an average of $74 weekly for child care expenses ($49.50 by families below the poverty level and $76 by families above the poverty level).[13] More significant than actual dollar expenditures were the findings that:

- ☐ Families below the poverty level spent 17.7 percent of family monthly income for child care, compared to 7.3 percent for families above the poverty level.
- ☐ Families that were recipients of various support programs (AFDC, WIC [Women, Infant and Child food support program] and Food Stamps) spent between 12 percent and 17 percent of monthly income for child care, compared to 7.3 percent for nonrecipients.
- ☐ Families with monthly incomes below $1,200 spent 25.1 percent of their income for child care, compared to 5.7 percent spent by families with monthly incomes of $4,500 and over.
- ☐ Single parent families spent a larger share of their family income on child care (12 percent) than married couple families (7 percent) (Table 2).

Table 2 ☐ Weekly child care costs paid for preschoolers by families with employed mothers: 1993.[14]

Characteristics	Weekly child care expenses	Percent of income spent per month for child care
Race/Hispanic origin		
White, not Hispanic	$76*	7.4%
African-American not Hispanic	61	8.5
Hispanic	66	9.0
Marital status		
Married, husband present	78	7.0
Never married	60	12.5
Monthly family income		
Less than $1,200	47	25.1
$1,200–$2,999	60	12.0
$3,000–$4,499	73	8.5
$4,500+	92	5.7
Poverty level		
Below poverty level	49	17.7
Above poverty level	76	7.3
Program participation		
AFDC	46	17.1
WIC	52	12.3
Food Stamps	45	14.6
Non-participant	78	7.3

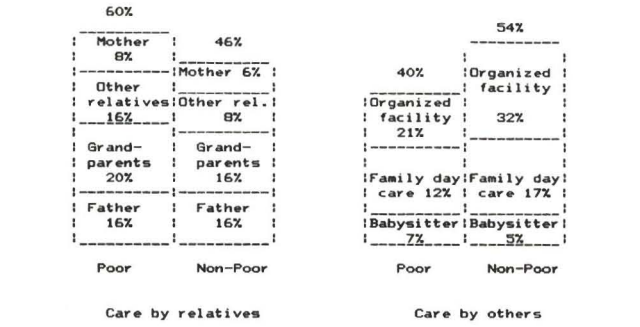
*Figures have been rounded to the nearest dollar.

Child care arrangements

Children who live with only one parent are much more likely to be cared for by their grandparents and other relatives than are children who live with married-couple parents.[15]

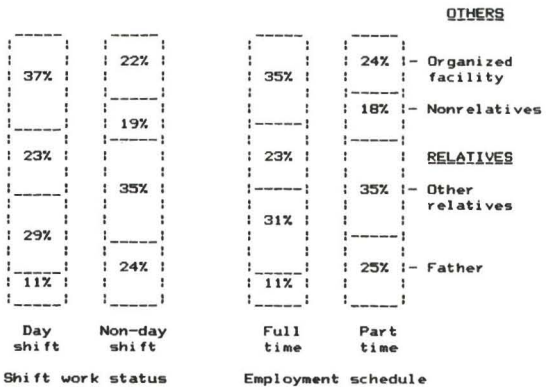
- ☐ Grandparents and other relatives provide a great deal of child care for preschoolers in poor families. Preschoolers in poor families were 50 percent more likely to be cared for by their grandparents and other relatives than were preschoolers in nonpoor families (36 percent vs 24 percent). In contrast, fathers and mothers were no more likely to provide child care in poor than in nonpoor families.
- ☐ Poor families are less likely to use organized child care facilities than nonpoor families, because child care in organized facilities is one of the most expensive of all types of child care arrangements (Figure 1).
- ☐ Organized child care facilities are more popular in the Southern Region of the country and in the suburbs. By contrast,
  - ☐ Preschoolers residing in central cities and nonmetropolitan areas are more likely than preschooler residing in the suburbs to be cared for by relatives.
  - ☐ Families in the Northeast Region are most likely to call on relatives to provide care for preschoolers. The greater use of relatives in the Northeast Region can be attributed to the greater use of fathers (1 in 4 preschoolers are cared for by their fathers).[14]
- ☐ Children in families receiving welfare benefits are more dependent on relatives to provide child care. Approximately 1.5 million preschoolers live in families that receive either general assistance, AFDC, Food Stamps or WIC funds.

‡See previous presentations in the *Journal of Dentistry for Children* for an extended review of the use of child care services and the overall expenses incurred in raising children.[16,17]



Note: Organized facilities include day care centers, nursery schools and about 1 percent of children in kindergarten or school based facilities

Figure 1. Child care arrangements for preschoolers by poverty status: 1993.[15]



Note: Other relatives include mothers, siblings, grandparents and other relatives

Figure 2. Child care arrangements for preschoolers by employment status of mother: 1993.[15]

- ☐ African-American and Hispanic mothers rely more heavily on their relatives to provide child care assistance while they are working than do White parents.[14]
- ☐ Mothers working evening or night shifts and part-time hours have an easier time arranging for relative and in-home care. The type of shift that a mother works makes a big difference in the kind of primary care arrangement that she uses. For example,
  - □ Among preschoolers whose mothers worked a day shift, 60 percent were cared for by someone who was not related to them, compared with 41 percent of children whose mothers worked non-day shifts.
  - □ Use of organized child care facilities was more prevalent for women working day shifts (37 percent) than working non-day shifts (22 percent). (Organized child care facilities may not be available during evening or weekend shifts.)
  - □ Preschool children of mothers employed full-time were less likely to be cared for by relatives (42 percent) than were mothers employed part-time (58 percent) (Figure 2).

In the past two decades, enrollment in nursery schools more than doubled from 1.2 million to 2.7 million three to four year olds. More recently in the 1990s, however, the proportion of children cared for by family day care providers (nonrelatives in the provider's home) and organized child care facilities declined. These declines may reflect 1) desires of parents to reduce child care costs or 2) increased difficulties in securing licensed family care providers.[18]

COMMENTARY

Single mothers, unmarried mothers less than 18 years of age, missing fathers and chronic welfare families have long been the target of the diatribes of politicians and the frustrations of tax payers. But if this review of the complex realities in our welfare system teaches us anything, "changing welfare as we know it" will be far more involved than passing legislation which curtails expenditures and passes responsibility to the states.

There are more than 15 million children (more than on in five) living in poverty in our communities. There are almost one million disabled children in our cities and towns. And there are thousands of children of noncitizen parents who will be removed from the Food Stamp and SSI programs.

As pediatric dental practitioners we can no overlook the potential impact of the legislation on these youngsters. Will this new welfare system ensure the safety and well-being of children? Is it reasonable to expect that single mothers who will need to seek employment position will have a satisfactory arrangement for child care?

No doubt the next number of years will be a difficult transitional period. Surely there will be efforts in the next Congress to transform some of the more glaring short comings in this new legislation. Note: the omnibus budget legislation for fiscal year 1997 (passed on September 30, 1996) modified Food Stamp cut off requirements for noncitizen, permitting recipients to remain on the rolls until April 1, 1997 and a few months longer in some cases.[6]

Change—yes, but what of our children? They must not be overlooked in our zeal to "change welfare as ....."

Addendum

As a result of a little noticed provision in the new welfare law, tens of thousands of welfare mothers have lost a monthly bonus (of approximately $50) for helping welfare officials collect child support from absent fathers. Hundreds of thousands more mothers are likely to lose these bonuses as increasing number of states institute the new federal welfare law regulations. In low benefit states (e.g. Louisiana and Mississippi) where the bonus constitutes as much as a quarter of the total welfare payment, the loss of the bonus will be most profound.

The bonus was created by Congress in 1984 to reward single mothers when the fathers of their children paid child support. The aim was to encourage the women to help welfare officials track down fathers who would not pay. During the ensuing years, however, there was much uncertainty that the bonus really worked.

Federal government share of the bonuses ranged from 50 percent (e.g. to California, Massachusetts and New York) to 76 percent (West Virginia) and 79 percent (Mississippi). The Congressional Budget Office estimates that the federal government will save $793 million through the year 2002 as a result of the termination of federal funding for these bonuses. States would assume the full cost of the bonus if they choose to continue the program after October 1, 1996.[19]

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Mid-1990s review of Medicaid and Medicaid dentistry

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Medicaid difficulties detailed in report on dental care access... Only one in five Medicaid-eligible children received preventive dental services in 1993..."[1] The 1996 report by the Inspector General of the Department of Health and Human Services on "Children's dental services under Medicaid: access and utilization" details the unavailability of dental care despite the "supposed" coverage for all oral services.[2] Of the 21.2 million Medicaid eligible children in 1993, only 4.2 million received preventive dental services. Report findings indicate that:

- ☐ Few dentists serve Medicaid children.
- ☐ Medicaid families give dental services a low priority.
- ☐ The youngest children are the most difficult to serve and frequently are not screened–as required by the Early, Periodic, Screening, Detection and Treatment Program (EPSDT).*

The limited availability of Medicaid dental services for children is but one component of the complex character of the whole Medicaid program and the extensive and intensive political efforts during the mid-1990s to control the spirally federal budget by curtailing the many entitlement programs. A previous article in the *Journal of Dentistry for Children* reviewed the particular characteristics of the Medicaid program and the efforts through the mid-1980s during the Reagan administration to control the program.[3] The following presentation will review a series of federal reports in an effort to update developments in the general Medicaid program through the mid-1990s at the federal and state levels, including:

- ☐ Comparisons with the evolving expenditures for overall general health services and dental care.
- ☐ Consideration of the realities of dentistry within the overall framework of the program.

OVERALL NATIONAL HEALTH EXPENDITURES

Personal health-care expenditures averaged $3,510 per person in 1994. Overall, almost a trillion dollars ($949.4 billion) or 13.3 percent of the gross domestic product were spent for health care. While national health spending rose 6.4 percent in 1994 and 7.0 percent in 1993, the rate of increase has slowed. For example, national health spending rose 12.9 percent in 1980 and on average, 11.3 percent a year from 1970 to 1994.[4,5†]

In 1993, national average per capita health expenditure was $3,020. Average per capita expenditures ranged

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*Medicaid's EPSDT is a comprehensive health program that provides for initial and periodic examinations and medically necessary follow-up care. Federal law requires that states provide EPSDT services to eligible children from birth through age 20. The two primary operational premises of EPSDT are access and utilization. The states must 1) assure that health care providers are available and accessible and 2) teach Medicaid families how to use available resources effectively.[2]

†Because limited comparative expenditure data are available for 1994, many references in this presentation will be to fiscal year 1993 information. The federal fiscal year begins on October 1st. The numbered year represents the year in which it ends. Thus fiscal year 1993 runs from October 1, 1992 to September 30, 1993.

Table 1 ☐ Regional total per capita personal health care expenditures, and overall and dental per capita expenditures as a percent of US spending: FY 1993.[5]

	Total per capita personal health care expenditure	Per capita spending as a percent of US average	
		Total care	Dental
Total U.S.	$3,020	100%	100%
New England	3,585	119	119
Middle Atlantic	3,523	117	108
Great Lakes	2,939	97	96
Plains	2,918	97	90
Southeast	2,875	95	83
Southwest	2,699	89	81
Rocky Mountains	2,497	83	106
Far West	2,956	98	129

from $2,497 in the Rocky Mountains Region (17 percent below the national average) to $3,585 in the New England Region (19 percent higher than the national average (Table 1). Between 1980 and 1993, spending per capita in the Southeast grew the fastest (10.1 percent annually). The Far West Region, with the highest concentration of Health Maintenance Organizations (HMOs), experienced the slowest growth (8.2 percent annually).[5]

OVERALL DENTAL EXPENDITURES

Expenditures for dental services grew to $37.4 billion in 1993 ($42.2 billion in 1994) increasing at a national annual average of 8.3 percent between 1980 and 1993.[6]

"This rate of growth made this component the slowest growing medical category... In 1980, spending for dental services was 6.2 percent of (personal health care expenditures) nationwide; by 1993, this share had dropped to 4.8 percent."[5]

Six states exhibited double digit average annual growth rates for dental services between 1980 and 1993: Alaska, New Hampshire, Maine, Utah, Florida and Nevada. Three states showed average annual growth rates below 7 percent: Michigan, Iowa and Montana. With the exception of Maine, states experiencing double digit growth in dental spending were growing more rapidly in population than the U.S. overall rate. Similarly, population growth in the slowest growing dental spending states was minimal or negative.[5]

By region, dental spending per capita ranged from 19 percent below the national average in the Southwest Region to 29 percent above the national average in the Far West Region. These spending differentials for dental services paralleled differences in 1) personal per capita income, except for the Rocky Mountain Region (where per capita incomes were below the national average) and 2) overall medical expenditures, except in the Rocky Mountain and Far West Regions (Table 1). Note: these spending differentials also paralleled the differences in the concentration of dentists by region (except in the Great Lakes Region where the concentration was at the national level).[5]

MEDICAID IN GENERAL

In 1993, Medicaid funds were expended for 85 percent of the population below the poverty level (an increase from the 65 percent to 75 percent level during the 1980s through 1990). Federal mandated increases in the coverage of pregnant women, children and some elderly populations significantly increased the availability of funds to cover the poor.[7] Total Medicaid expenditures reached $112.8 billion in 1993, representing 14.5 percent of all personal health care expenditures. Note: these funds include expenditures for other than direct personal care. In 1994, $107.9 billion were paid to vendors for personal health care services (Table 2).

The annual growth in Medicaid expenditures from 1980 to 1993 averaged 12.5 percent. From 1989 to 1992, however, the growth rates in total Medicaid spending

Table 2 ☐ Federal and state expenditures for Medicaid vendor services: selected fiscal years 1972–1994.[8-11]

Fiscal year	Number of persons below poverty line (in millions)	Number of Medicaid recipients (in millions)	Expenditures (in billions)	Expenditure per recipient	Medical care component CPI index (1982–84 = 100)	Constant dollars	
						Total expenditures (in billions)	Expenditures per recipient
1972	25.4*	17.6	$6.3	$358	37.3	$16.9	$960
1975	25.9	22.0	12.2	556	47.5	25.7	1,170
1980	29.3	21.6	23.3	1,079	74.9	31.1	1,441
1935	33.1	21.8	37.5	1,719	113.5	33.0	1,514
1990	33.6	25.3	64.9	2,565	162.8	39.9	1,577
1994	39.3**	35.1	107.9	3,080	211.0	51.1	1,460

*1970 datum
**1993 datum
Note: Vendor payments do not include other associated expenses (e.g. administrative costs, qualitative and quantitative review of services)

Table 3 ☐ Total Medicaid personal health service expenditures by federal, state and local sources of funds: selected calendar years 1970–1994.[6,12-14]

Year	Federal	State & local (in billions)	Total	Percent federal
1970	$2.9	$2.4	$5.3	54.7%
1975	7.6	6.0	13.6	55.9
1980	13.7	11.1	24.8	55.2
1985	21.9	17.9	39.8	55.0
1990	40.6	31.2	71.8	56.5
1994	81.5	47.8	129.3	63.0

exceeded this thirteen year average. The largest growth rates (21.2 percent and 25.5 percent, respectively) occurred in 1990 and 1991. Nationally, the Medicaid expenditure growth rate slowed to 8.7 percent in 1993, primarily as a result of the deceleration in Medicaid hospital expenditures.

In the past twenty-five years overall national Medicaid expenditures increased both in terms of current and constant dollars (removing the effects of inflation). During the 1990s, however, constant dollar Medicaid spending per recipient has not kept pace with the rate of inflation (Table 2).

In order for states to receive federal matching funds, a series of minimum services must be provided to all specified groups of Medicaid recipients, including: the aged, blind, disabled, dependent children less than 21 years of age, and adults in families with dependent children.[1]

The percent of Medicaid funds paid by the federal government is determined each year by a formula using the average per capita income level of each state as compared with the national level.

In 1995, the percentage varied from 50 percent paid to thirteen states and the District of Columbia to 78.58 percent paid to Mississippi.[8] In 1994, expenditures by the federal government represented 63 percent of total Medicaid funds spent by all levels of government (an increase from approximately 55 percent during the 1980s) (Table 3).

MEDICAID FOR CHILDREN

Since 1980, there have been decreases in the proportionate share of funds spent for the aged and increases in the share of funds for the disabled and dependent children (Table 4).

Nevertheless in fiscal year 1994, while children represented almost half (49 percent) of all Medicaid beneficiaries, their service needs received only 16 percent of Medicaid expenditures. By contrast, the aged represented 12 percent of Medicaid benefit recipients and 31 percent of expenditures, the blind and disabled represented 16 percent of recipients and 39 percent of expenditures (Figure 1).

Thus while states and federal governments spent an average of $3,400 per person on Medicaid, spending varied significantly for the different populations:

- ☐ $1,200 per child;
- ☐ $8,400 per person with disabilities;
- ☐ $9,100 per elderly beneficiary.[15]

Medicaid currently covers over 18 million children: one out of every five children in the nation. About a third of all babies born in the United States are covered by Medicaid. Over 90 percent of children with AIDS are covered by Medicaid.

The number of Medicaid beneficiaries under age 21 has increased from 9.8 million in 1985 to 18.2 million in 1994. In 1993, Medicaid covered 63 percent (10.5 million) of all children under 100 percent of the poverty level. Medicaid covered 44 percent (13.8 million) of all children under 185 percent of the poverty level (Figure 2).

MEDICAID BY STATE

There is marked variation by state in the number of recipients and the expenditures of funds per recipient. In 1994, the number of Medicaid recipients by state ranged from less than one hundred thousand persons in each of nine states (Alaska, Delaware, Montana, Nevada, New Hampshire, North Dakota, South Dakota, Vermont, and Wyoming), to more than one million persons in six states (Florida, Georgia, Illinois, Michigan, Ohio, and Pennsylvania), more than 2.5 million in Texas, almost three million in New York and almost five million in California.

- ☐ Expenditures per recipient ranged from $390 in Arizona (which provides services through a prepaid

[1]The federal government's definition of minimum services includes: inpatient and outpatient hospital services, physician care, rural health clinic services, laboratory and x-ray services, nurse-practitioner and nurse-midwife services, nursing home and home-care services, EPSDT, family planning services and supplies, and services of other health professionals.

States also can receive funds if they elect to provide other optional services. As of October 1994, there were 34 different optional services that states could choose to provide, including: dental, podiatric, optometric, and chiropractic services. There is considerable variation among states as to the types of optional services that are provided. The states offering the most optional services are Wisconsin (31 services), Illinois, Indiana, and Minnesota (30 services). Louisiana and Delaware offer only 15 of the 34 optional services. All states offer prescription drug services.[5]

Table 4 ☐ Percent distribution of federal and state Medicaid expenditures by eligibility category: selected fiscal years 1975–1994.[8]

Fiscal year	Aged 65 & over	Blind	Disability	Dependent child < 21 years	Adult in family with depend. child	Other	Total
1975	35.6%	0.8%	24.9%	17.8%	16.8%	4.0%	100%
1980	37.5	0.5	32.2	13.4	13.9	2.6	100
1985	37.8	0.6	35.2	11.8	12.6	2.1	100
1990	33.3	0.6	36.9	14.0	13.2	1.9	100
1994	31.3	0.6	38.5	16.0	12.5	1.4	100

Note: Totals differ due to rounding

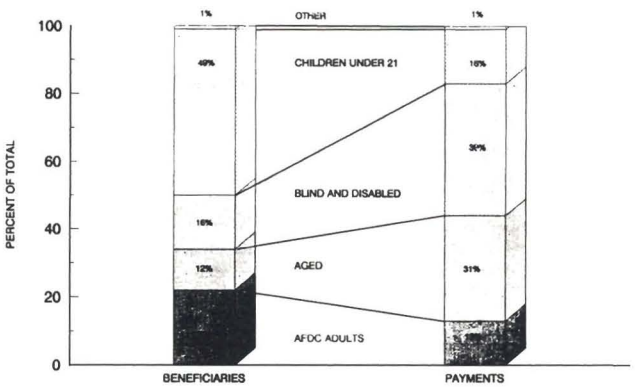

Figure 1. Percent distribution of Medicaid beneficiaries and payments by basis of eligibility: FY 1994.[15]

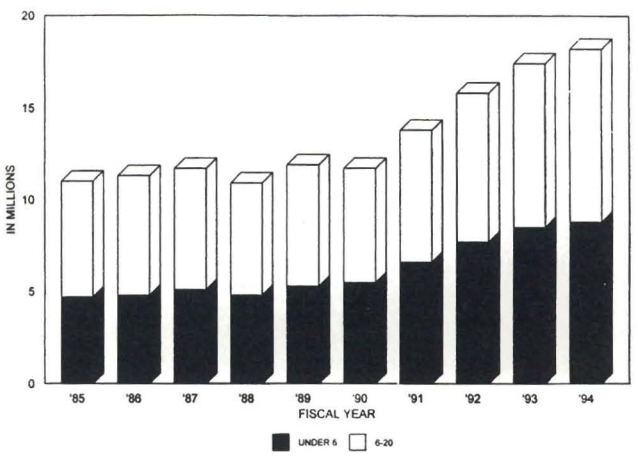

Figure 2. Medicaid beneficiaries under age 21: FY 1988–1994.[15]

demonstration arrangement), $1,995 in California and $2,030 in Mississippi, to $5,968 in Rhode Island and $6,441 in New York.

- ☐ In 1993, expenditures per recipient in thirty states were below the national average. In Alabama, California, Mississippi, New Mexico, Tennessee and Texas expenditures per recipient were more than 25 percent below the national average.
- ☐ In Connecticut, District of Columbia and Minnesota expenditures per recipient were more than 50 percent above the national average. In New York expenditures per recipient were almost double the national average.
- ☐ The ratio of recipient per population was more than 25 percent below the national average in nine states (Colorado, Hawaii, Idaho, Maryland, Minnesota, New Hampshire, Utah, Virginia, and Wisconsin). In Nevada, the ratio was one half of the national average; while in the District of Columbia, Mississippi, Rhode Island, and West Virginia it was at least 50 percent greater than the national average (Table 5).

MEDICAID DENTISTRY

"In no state do more than half the eligible (EPSDT) children from low-income families receive such services as instruction in self-care oral hygiene, a teeth cleaning or dental sealant when appropriate; three-fourths of the states provided these services to fewer than 30 percent of eligible children."[1]

The limited availability of dental services for children in the EPSDT program should be considered in terms of 1) the general decreasing proportionate share of health expenditures for dental care and 2) the more specific marked decreasing share of expenditures for dental care for all Medicaid recipients.

- ☐ Between 1980 and 1993, the dental care "...component (was) the slowest growing medical category..."[5] As a result, dentistry's share of national expenditures for personal health services decreased from 6.2 percent to 4.8 percent.[5] (Note: a May 1996 press release by the publication *Health Affairs* reports data which indicate that in 1994, dentistry's share of national expenditures for personal health services decreased further to 4.4 percent.[16])
- ☐ Between 1975-1985 and 1985-1994, the Medicaid dental expenditure share of all Medicaid spending decreased, 57 percent and 25 percent, respectively. Between 1975 and 1994, the Medicaid dental expenditure share of all Medicaid spending decreased

Table 5 ☐ Medicaid expenditures and recipients by state: 1993, 1994.[5,8]

	FY 1994 Medicaid recipients (in thousands)	FY 1994 Medicaid vendor payments for total health services per recipient	FY 1993 Cost per recipient index*	FY 1993 Recipients per population index**
Alabama	544	$2,414	0.71	0.98
Alaska	69	3,531	1.22	0.86
Arizona	510	390***	0.91	0.81
Arkansas	340	3,687	0.86	1.10
California	5,008	1,995	0.68	1.22
Colorado	289	3,288	1.00	0.62
Connecticut	354	5,482	1.73	0.80
Delaware	75	3,699	1.05	0.78
Dist. Columbia	127	4,326	1.63	1.64
Florida	1,727	2,470	0.78	1.00
Georgia	1,085	2,623	0.83	1.09
Hawaii	121	2,798	0.93	0.74
Idaho	110	3,010	0.84	0.71
Illinois	1,441	3,349	0.96	0.94
Indiana	605	3,721	1.42	0.78
Iowa	303	3,244	0.96	0.81
Kansas	252	3,105	0.92	0.76
Kentucky	638	2,790	0.79	1.29
Louisiana	778	3,449	1.03	1.38
Maine	177	4,558	1.24	1.07
Maryland	415	4,517	1.25	0.71
Massachusetts	710	4,296	1.40	1.00
Michigan	1,187	2,759	0.96	0.98
Minnesota	426	3,889	1.52	0.74
Mississippi	537	2,030	0.60	1.51
Missouri	669	2,705	0.78	0.92
Montana	96	3,148	1.05	0.84
Nebraska	164	3,604	0.99	0.81
Nevada	95	3,213	1.13	0.50
New Hampshire	88	4,848	1.63	0.56
New Jersey	790	4,573	1.41	0.80
New Mexico	268	2,380	0.69	1.18
New York	2,908	6,441	1.91	1.19
North Carolina	985	2,725	0.83	1.02
North Dakota	63	4,522	1.25	0.77
Ohio	1,523	3,279	0.91	1.06
Oklahoma	391	2,494	0.76	0.94
Oregon	411	2,519	0.85	0.85
Pennsylvania	1,255	3,365	1.21	0.80
Rhode Island	115	5,968	1.20	1.51
South Carolina	486	2,871	0.82	1.02
South Dakota	72	3,936	1.10	0.77
Tennessee	939	2,093	0.70	1.41
Texas	2,514	2,443	0.74	1.01
Utah	157	2,871	0.93	0.63
Vermont	94	2,756	0.83	1.10
Virginia	643	2,680	0.82	0.70
Washington	668	2,355	0.99	0.95
West Virginia	367	3,018	0.90	1.51
Wisconsin	474	3,863	1.31	0.74
Wyoming	51	3,111	0.86	0.78
Puerto Rico	927	251	na	na
Virgin Islands	16	478	na	na
Total US.	35,056	$3,080	1.00	1.00

*Calendar year state health expenditures divided by fiscal year recipient count and compared to national average of 1.00
**Fiscal year recipient count divided by calendar year population counts and compared to national average of 1.00
***Arizona provides medical assistance through a prepaid demonstration arrangement

by 68 percent (double the rate to the nearest component—physician service expenditure share decreased by 34 percent) (Table 6).

☐ Medicaid dental services represented 1.4 percent of total Medicaid expenditures in 1993 and 1.2 percent in 1994, compared to 2.0 percent in 1980.[6,14]

☐ Total current dollar Medicaid dental expenditures and spending per recipient for Medicaid dental services have increased each year. Since 1975, however, constant dollar (removing the effects of inflation) total and per recipient spending have not kept pace with the rates of inflation. In 1994, constant

Table 6 ☐ The percent distribution of total federal and state Medicaid benefit expenditures by type of service: selected fiscal years 1975–1994 and percent change in distribution between 1975–1985, 1985–1994 and 1975–1994.[8]

Service category	1975	1980	1985	1990	1994	Percent change 1975–1985	Percent change 1985–1994	Percent change 1975–1994
Hospital in-patient	30.8%	30.8%	28.4%	28.3%	26.1%	−7.8%	−8.1%	−15.2%
Intermediate care facility (for mental retarded)	3.1	8.5	12.6	11.3	7.7	306.5	−38.9	148.4
Skilled nursing home	35.2	33.8	30.8	27.3	24.9	−12.5	−19.2	−29.3
Physician services	10.0	8.0	6.3	6.2	6.6	−37.0	4.7	−34.0
Dental services	2.8	2.0	1.2	0.9	0.9	−57.1	−25.0	−67.9
Prescribed drugs	6.7	5.7	6.2	6.8	8.2	−7.5	32.2	22.3
Home health services	0.6	1.4	2.9	5.2	6.5	383.3	124.1	983.3
Other services*	13.3	9.8	11.6	14.0	19.1	−12.8	64.6	43.6
Total	100%	100%	100%	100%	100%			

*Includes services in or associated with the following categories: other practitioners, clinics, laboratory and radiological services, family planning and "other care"

Table 7 ☐ Federal and state expenditures to vendors for Medicaid dental services: selected fiscal years 1972–1994.[8-10]

Year	Total expenditures (in millions)	Number of recipients (in millions)	Expenditure per recipient	Dental component CPI index (1982–84 = 100)	Constant dollars: Total expenditures (in millions)	Constant dollars: Expenditure per recipient
1972	$170	2.4	$71	43.4	$392	$163
1975	339	3.9	86	52.2	649	165
1980	462	4.7	99	78.9	586	126
1985	458	4.7	98	114.2	401	86
1990	593	4.6	130	155.8	381	84
1994	969	6.4	153	197.1	492	78

dollar expenditures per recipient were less than half the amount spent in the mid-1970s (Table 7).

MEDICAID DENTISTRY BY STATE

The marked variation by state in general Medicaid expenditures is continued in the spending profile for dental services. In 1994,

Recipients

- ☐ Twenty-one (21) states and the District of Columbia provided Medicaid dental services to fewer than fifty thousand children and/or adults.
- ☐ Four (4) states (Georgia, Massachusetts, New Jersey, and North Carolina) provided Medicaid dental services to more than two hundred thousand children and/or adults.
- ☐ Texas and New York provided services, respectively, to more than 400,000 and/or 800,000 children and adults.

Spending

- ☐ New York spent $156 million for Medicaid dental services, while eight (8) states (Arizona, Delaware, Maine, Maryland, Mississippi, New Hampshire, New Mexico, and North Dakota) and the District of Columbia spent less than $5 million for Medicaid dental services.
- ☐ Eight (8) states (Arizona, Maine, Maryland, Michigan, Mississippi, Ohio, Pennsylvania, and Tennessee) spent less than $100 for Medicaid dental services per child and/or adult dental care recipient.
- ☐ Three (3) states (Alaska, Nevada, and Rhode Island) spent more than $300 for Medicaid dental services per recipient (Table 8).

FINAL THOUGHTS

Despite a general awareness that limited resources are available for Medicaid dental services, it is difficult to accept the reality that less than one percent of the children eligible under the EPSDT program received preventive dental services in Arizona and Hawaii. In addition, less than 10 percent of EPSDT eligible children received preventive dental services in Kentucky, Montana, New Mexico, and North Dakota (Table 8).

But this is not the first time that federal agencies have described the inability of eligible EPSDT youngsters to receive dental services. The Congressional Office of Technology Assessment reported in 1990 that, "...none of the State Medicaid programs adequately covered children's basic dental services..."[17]

Table 8 ☐ Medicaid dentistry by state: FY 1993.[2,5]

	Total expenditures for Medicaid dental care (in millions)	Number of Medicaid dental recipients (in thousands)	Medicaid dental expenditure per recipient	Number of EPSDT eligible children (in thousands)	Percent of EPSDT children that received preventive dental services
	FY 1994	FY 1994	FY 1994	FY 1993	FY 1993
Alabama	$8.5	68.2	$124	279.1	11.2%
Alaska	7.9	21.1	373	51.7	28.0
Arizona	2.8	82.8	34	413.1	0.3
Arkansas	6.9	46.3	151	207.1	16.9
California	10.3*	44.6*	229*	3,583.9	16.8
Colorado	5.9	53.9	109	210.7	21.0
Connecticut	22.1	129.7	170	193.1	27.2
Delaware	0.8	6.4	124	50.6	12.2
Dist. Columbia	1.6	15.1	107	73.8	16.0
Florida	57.8	320.6	180	1,355.0	16.4
Georgia	32.4	251.2	129	643.4	25.1
Hawaii	8.6	42.5	201	68.0	0.7
Idaho	7.6	31.8	238	71.3	21.0
Illinois	0.4*	0.6*	76*	1,027.0	20.9
Indiana	28.9	182.1	159	345.8	41.6
Iowa	20.4	115.2	178	169.5	33.2
Kansas	7.1	45.2	158	113.2	35.4
Kentucky	38.9	163.8	225	293.1	9.4
Louisiana	29.9	161.0	186	498.4	25.7
Maine	3.5	35.7	98	106.8	34.5
Maryland	3.1	42.2	74	229.1	14.5
Massachusetts	45.2	278.1	163	404.9	34.4
Michigan	34.0	374.4	91	823.1	26.2
Minnesota	19.1	143.1	133	291.5	25.2
Mississippi	2.5	27.3	91	470.0	12.1
Missouri	17.9	168.3	106	403.7	21.5
Montana	4.9	29.6	166	57.0	9.0
Nebraska	7.2	59.5	121	102.3	33.5
Nevada	5.9	17.3	337	34.8	14.4
New Hampshire	3.9	23.1	171	40.0	44.8
New Jersey	34.3	233.9	147	447.3	22.7
New Mexico	4.9	31.2	157	133.5	6.2
New York	156.1	832.6	188	1,585.8	17.9
North Carolina	34.4	206.9	165	550.6	13.8
North Dakota	3.4	19.5	175	32.8	8.0
Ohio	38.2	397.8	96	948.6	22.8
Oklahoma	6.5	49.2	133	162.6	19.0
Oregon	7.0	45.4	155	206.5	34.7
Pennsylvania	29.2	310.8	94	880.0	21.1
Rhode Island	8.2	27.2	301	66.1	31.8
South Carolina	14.0	114.5	123	302.5	12.5
South Dakota	1.4	8.2	166	47.7	17.9
Tennessee	7.1	74.2	96	534.2	24.3
Texas	83.6	411.9	203	1,330.5	12.0
Utah	5.9	44.3	133	123.9	15.5
Vermont	5.8	36.4	159	52.3	33.8
Virginia	12.6	103.4	122	328.1	19.7
Washington	39.9	198.7	201	304.2	29.3
West Virginia	16.5	72.2	228	135.6	30.6
Wisconsin	16.0	141.4	113	342.7	22.5
Wyoming	1.7	9.4	183	34.9	43.3
Total US.	$986.7	6,361.9	$153	21,200.0	19.7

*Data are not complete
Note: Numbers may differ due to rounding
Information source includes (Personal communication, June 1996, Health Care Financing Administration, Bureau of Data Management, HCFA – 2082 Report)

Unfortunately, the problems facing the general Medicaid program and Medicaid dentistry in particular are continuing despite the series of federal reports. For example, in response to federal requirements to increase services for EPSDT eligible children by improving fee structures, thereby encouraging dentists to participate in the program, numbers of states have eliminated various types of dental services or total dental services for Medicaid eligible adults.

As this material is being prepared in the late spring

Table 9 ☐ Children living in poverty by various demographics: 1994.[20]

	Number (in millions)	Percent of all children
Race/Hispanic origin		
White	9.3	16.9%
African-American	4.9	43.8
Hispanic*	4.1	41.5
Total**	15.3	21.8
In households with incomes below 50% of poverty level		
White	3.7	
African-American	2.7	
Hispanic*	1.7	
Region		
Northeast	1.1	
Midwest	1.5	
South	2.8	
West	1.4	
Location		
Metropolitan area	5.5	
Nonmetro. area	1.4	

*May be of any race
**Includes other children not listed separately

of 1996, Congressional Republican leaders released their latest proposal to reform Medicaid, which included proposals to:

- ☐ Give states the option not to phase in coverage for children 13-17 years of age over the next five years.
- ☐ Give states complete flexibility to determine the amount, scope, and duration of services provided to Medicaid recipients; thus allowing states to institute a leaner package of services in order to achieve budget saving by reducing services to children, the blind, disabled and elderly.[18]

The previous review in the *Journal of Dentistry for Children*, written almost ten years ago, ended with the following quotation and commentary.[3]

" '...the single most important health program for low-income children, accounting at one time for over 55 percent of all public health expenditures for children...'[19] has changed. But what of Medicaid dentistry? And what of the 12.3 million children who live below the federally defined poverty level?"[2]

About the only change needed in this current presentation in the mid-1990s is in the final commentary. It should read, "and what of the more than 13 million children (more than one child in five) who live below the federally defined poverty level?" What of the:

- ☐ More than 40 percent of minority children who live in poverty?
- ☐ More than 6 million children who live in households with incomes that are less than 50 percent of the poverty level, including 1) more than one million children who live in each geographic region of the country, 2) more than 5 million children who live in metropolitan communities, and 3) more than 1 million of which live in nonmetropolitan areas? (Table 9)
- ☐ More than 5.5 million children of working poor (an increase of 65 percent in the past two decades)?[21]

Although Medicaid dental expenditures represent 3.8 percent of all spending for dental services, it may well represent the only avenue for financial support for those least able to afford needed care.[16]

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ABSTRACTS

Fukuta, Osamu; Braham, Raymond L.; Yanase, Hiroshi *et al*: Intranasal administration of midazolam: Pharmacokinetic and pharmacodynamic properties and sedative potential. J Dent Child, 64:89-98, March-April 1997.

This study investigated the pharmacodynamic effects and sedative potential of midazolam administered by the intranasal route to adult volunteers. A double-blind, randomized, controlled study was carried out on seventeen healthy, male volunteers to study plasma level changes, sedative effects and variations in vital signs following intranasal administration of 0.2 mg/kg and 0.3 mg/kg doses of midazolam. Eight subjects received 0.2 mg/kg midazolam, seven received 0.3 mg/kg. Each subject rested for 15-20 minutes after placement of vital sign monitors and venipuncture needles before administration of midazolam. Behavior during the rest period was designated as the control so that each subject acted as his own control. Each subject's behavior was assessed on a scale of 1 (asleep) to 8 (excited). Plasma concentrations of midazolam were analyzed using venous blood samples from each of three randomly selected subjects for each of the two doses. Vital signs, monitored continuously, included electrocardiogram, heart rate, blood pressure, respiratory rate and oxygen saturation (SPO_2). Plasma concentration of midazolam in both groups maintained adequate sedation levels with each group sustaining favorable sedation conditions from 15-20 minutes to 55-60 minutes. Individual variations of midazolam plasma concentration within the 0.3 mg/kg group were greater than those of the 0.2 mg/kg group. Normal vital sign variations due to the nasal instillation of midazolam were observed in both groups. Some minor respiratory depression was observed in the 0.2 mg/kg group. One instance of severe respiratory depression was observed in the higher dose group. Although both doses of midazolam were effective, no benefit was observed using a dose of 0.3 mg/kg. Indeed, a 0.3 mg/kg intranasal dose of midazolam may actually produce severe respiratory depression.

Midazolam; Intranasal administration, Sedation

Rousset, C.; Lambin, M.; Manas, F.: The ethological method as a means for evaluating stress in children two to three years old during a dental examination. J Dent Child, 64:99-106, March-April 1997.

A dental examination could be perceived by small children as an "at-risk" situation. The behaviors observed in these children during a dental examination depend not only on the examination situation but also on other factors, such as the sex of the child or the sex of the accompanying parent. The ethological method provided a means for evaluating behavioral differences due to the sex of the child and that of the accompanying parent. Results showed that girls appeared better able to master the examination situation than did boys, regardless of the sex of the accompanying parent. The girls appeared more secure, and exhibited more exploratory behavior than did the boys. The boys, on the other hand, appeared less secure than did the girls especially when the father was the accompanying parent.

Pediatric stress; Ethological method

Kreulen, C.M.; de Soet, H.J.J.; Hogeveen, R. *et al*: Streptococus mutans in children using nursing bottles. J Dent Child, 63:107-111, January-February 1997.

This study aimed at comparing *S.mutans* in pairs of children within families; both children used a sweetened nursing bottle beyond the dietary need, while one child was affected with nursing bottle caries (NBC), the other not. Seven families were selected. The children of a pair showed no dissimilarities as regards dietary habits. Mean patient-age was 3.7 yrs, controls 5.7 yrs. Saliva and plaque were sampled for CFU-counting and clonal (DNA) type-screening of *S.mutans*. The NBC-patients harbored significantly more *S.mutans* than the controls (mean 5.8 CFU/ml vs. 2.9 CFU/ml). While the controls were colonized with 2-5 clonal types of *S.mutans*, in the patients only one type was observed. The results were not consistent for NBC-risk assessment by CFU-counting. An inverse relationship between the number of clonal *S.mutans* types and NBC is suggested.

Nursing bottle caries; *S.mutans* types; DNA typing

Harrison, Rosamund; Wong, Tracy; Ewan, Cindy; Contreras, Beverly; Phung, Yvonne: Feeding practices and dental caries in an urban Canadian population of Vietnamese preschool children. J Dent Child, 64:112-117, March-April 1997.

The aim of this project was to determine the severity of nursing caries, and to examine contributing behavioral factors, in a group of Vietnamese families in British Columbia, Canada. The data collected became the basis for a community-based oral health promotion program. Information on feeding, dental health practices, and dental caries were collected for 60 mother/child pairs. For children ≥18 mos, prevalence of nursing caries was 64 percent. Sixty-five percent of all children had a naptime bottle, and 85 percent ≥18 mos had a "comfort" bottle that was carried around, and drunk from during the day. Milk was the most common beverage. A "comfort" bottle was significantly related to the presence of nursing caries, $P=0.02$; a naptime bottle had a less significant association, $P=0.07$. Dental knowledge questions revealed that all mothers knew that a child who had a "comfort" bottle could get tooth decay, but 63 percent thought that cavities were not a problem in baby teeth.

Dental caries experience; Ethnic groups; Feeding patterns; Infants; Nursing caries; Preschool children

Wrbas, Karl-Thomas; Kielbassa, Andrej M.; Hellwig, Elmar: Microscopic studies of accessory canals in primary molar furcations. J Dent Child, 64:118-122, March-April 1997.

The purpose of this study was to evaluate the incidence of accessory canals in the furcation region of human primary second molars. Forty freshly extracted teeth were radectomized and furcations were separated. The severed pulp chamber floors were decalcified and dehydrated. Paraffin embedding followed and cross-cut serial sections were taken from the specimens. Microscopic examination of each section followed. Sixteen out of twenty (80 percent) of the maxillary and fifteen out of twenty (75 percent) of the mandibular primary second molars demonstrated accessory foramina in the furcation area. 17.3 percent of the accessory foramina were found in the pulp chamber floor and 82. 7 percent were observed interradicular, close to the periodontal ligament. Thirty percent of the primary second molars demonstrated accessory canals, running from the pulp chamber to the periodontal ligament. Within the limitations of a microscopic investigation it is assumed that accessory furcation canals might be responsible for interradicular bone pathology in case of pulpal inflammation or necrosis.

Primary second molars; Accessory canals

Kuusela, Sisko; Honkala, Eino; Rimpelä: How does the use of different sugar products predict caries in 18-year-old Finns? J Dent Child, 64:123-127, March-April 1997.

The aim of this study was to determine whether self-reported (but diagnosed previously by a dentist) caries incidence of eighteen-year-olds could be predicted based on their use of sweets, cakes, sugar-sweetened coffee or tea between the ages of twelve and eighteen. The data were collected as part of the nationwide research program, the Adolescent Health and Lifestyle Survey. All Finns born in 1968 and having their birthdays on 20-25th July formed the sample (N = 1106). The 1981 survey (adolescents at the age of twelve) was the baseline, and follow-up questionnaires were sent in 1983, 1985 and 1987. The chi-square test and logistic regression model were used in the analyses. Different sugar products were slightly more significant predictors with the chi-square test than by logistic regression model. Among boys, the most common predictor, daily use of sugar-sweetened coffee, was an important predictor, although the risk was quite low. For girls, no predictors were found.

Adolescents; Caries incidence; sugar consumption; Health behavior; Finland

Donly, K. J. and Ingram, C.: An in-vitro caries inhibition of photopolymerized glass ionomer liners. J Dent Child, 64:128-130, March-April 1997.

Caries inhibition of traditional chemical cure glass ionomers has been established. The newer photopolymerized glass ionomers demonstrate a different composition that may impair the ability of providing prevention to secondary caries at restoration margins. The purpose of this study was to evaluate the caries inhibition of photopolymerized glass ionomers (Vitrebond®-3M Dental Products, Photac® Bond-ESPE/Premier Dental Products) compared to a photopolymerized composite resin (Pertac® Universal Bond-ESPE/Premier) control.

Two standardized Class V preparations were placed in thirty permanent molars, the gingival margin placed below the cementoenamel junction. Equal numbers of preparations were restored with Vitrebond®, Photac® Bond and Pertac® Universal Bond, according to manufacturer's instructions. The teeth were coated with an acid resistant varnish to within 2 mm of the restoration margins. All teeth were subjected to an artificial caries challenge (pH 4.2) for five days, then axial sections of 100 μm were cut longitudinally through the restored margins and photographed under polarized light microscopy. The polarized micrographs were projected onto a digitizing pad, where demineralized areas adjacent to the restoration margins were quantitated.

Results demonstrated the mean (± S.D.) area (μm^2) demineralization 100 μm from the restoration gingival margin to be: Photac® Bond 66.1 ± 27.8; Vitrebond® 47.2 ± 37.2; Pertac® Universal Bond 120.9 ± 66.0. Duncan's multiple range test indicated there was no statistically significant difference in demineralization inhibition between the two photopolymerized glass ionomers Photac® Bond and Vitrebond® ($p < 0.05$), but both photopolymerized glass ionomers demonstrated significantly less demineralization than the Pertac® Universal Bond composite resin control ($p < 0.05$).

Photopolymerized glass ionomers; Vitrebond; Photac Bond; Photopolymerized composite resin; Pertac Universal Bond

Vaikuntam, Jay: Resin modified glass ionomer cements (RM GICs): Implications for use in pediatric dentistry. J Dent Child, 64:131-134, March-April 1997.

The changing face of restorative dentistry has resulted in the introduction of numerous materials. The emphasis on durability, strength, and esthetics led to the introduction of glass ionomer based formulations. The latest entrants into this arena are the resin-based glass ionomer cements. The combined properties of enhanced strength and fluoride release make this material an attractive choice for most restorative procedures. For the pediatric dentist, this material has special value due to its preventive characteristics, ease of placement and esthetics. The amalgam controversy has led practitioners and patients to opt for non-amalgam based restorations. The introduction of "compomers" provides an exciting alternative to amalgam. The purpose of this article is to highlight the properties of these "new age" materials and present a case report on the use of one such commercially available resin/ionomer cement.

Glass ionomer cement; Resin-modified; Pediatric dentistry

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ABSTRACTS CONTINUED FROM PAGE 86

Waldman, H. Barry: Changing welfare as we know it: Some thoughts about the impact on children. J Dent Child, 64:135-140, March-April 1997.
The new federal welfare legislation eliminates an entitlement to benefits or services for different groups of recipients. A review is provided of some of the legislative provisions and their consequences, with particular concern for the impact on children. The availability and use of child care arrangements for working parents illustrates the complexity of "transforming welfare as we know it."
Welfare legislation; Children

Waldman, H. Barry: Mid 1990s review of Medicaid and Medicaid dentistry. J Dent Child, 64:141-148, March-April 1997.
In light of a federal report on the extremely limited availability of preventive dental services for children under the Medicaid program, a review is provided of the evolving comparative share of general health expenditures and Medicaid funds that are spent on dental services. The findings indicate that during the 1990s, dentistry in general and within the Medicaid program occupies a continuing decreasing share of expenditures.
Medicaid; Medicaid dentistry