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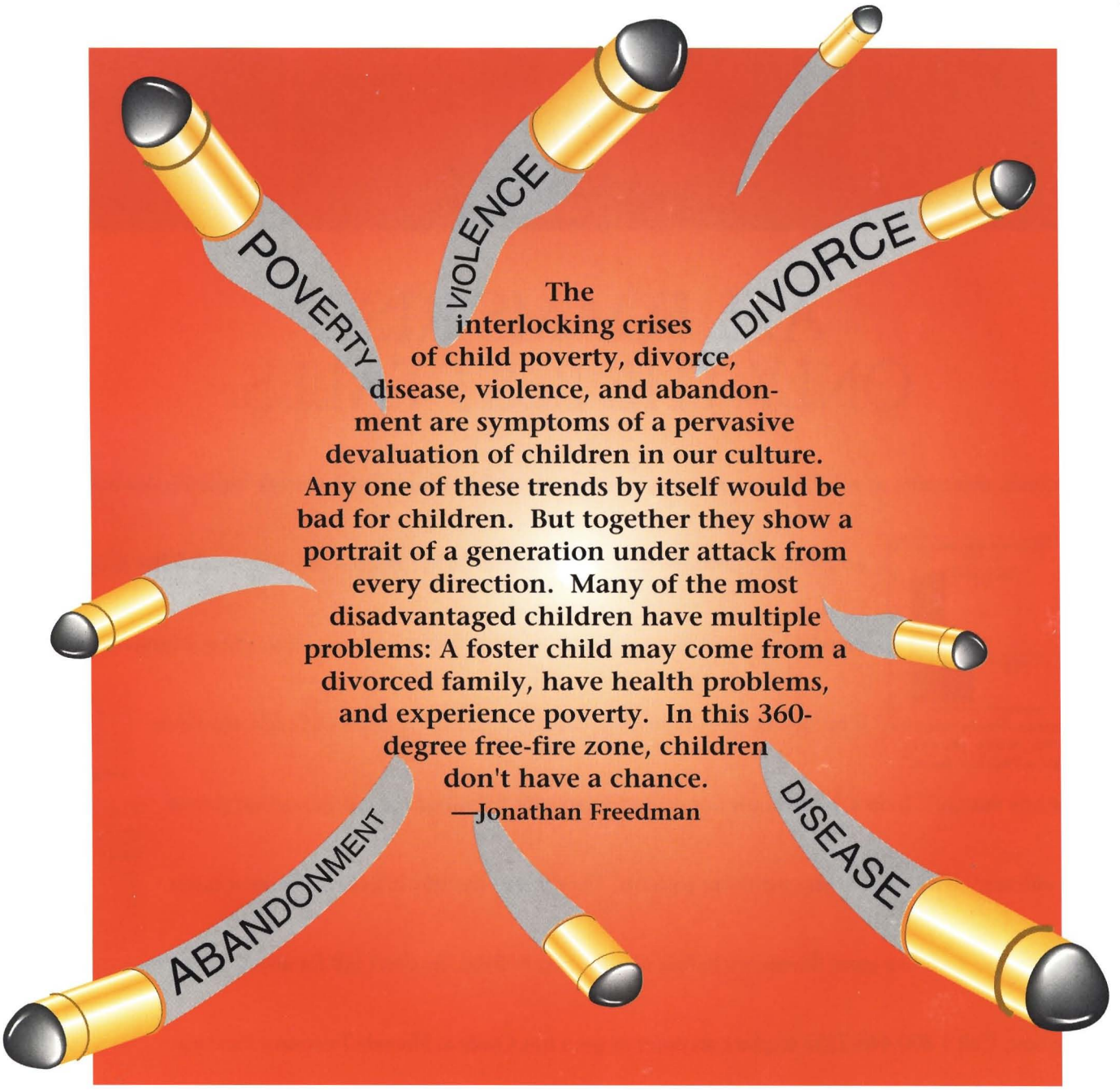

"CHILDHOOD HAS BECOME FAR MORE PRECARIOUS AND LESS SAFE FOR MILLIONS OF AMERICA'S CHILDREN"
A 1989 Congressional Study

Handicaps • STEREOTYPE • Sexism
Children in Crisis

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Children today are under attack from every direction. The types of crises and the growing numbers of children caught in them are symptoms of a pervasive devaluation of children in our culture.
Art and design by Sharlene Nowak-Stellmach

CHILD ABUSE

PLAQUE

CLINIC

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Year	Number killed	Percent killed with a gun
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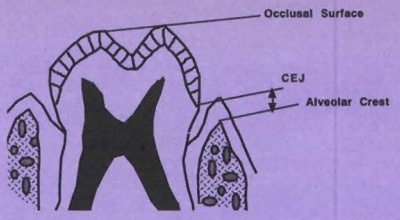
1993	2,841	49.9
1994	2,660	47.6

188



205

INFANT CARIES

DEMOGRAPHICS

CASE REPORTS

Calendar

1997

National Symposium on Biomaterials in Pediatric Dentistry, Radisson Hotel Metrodome, Minneapolis, MN, September 5-6.
AAON-IAPD '97, Buenos Aires, Argentina, September 17-20
Early Childhood Caries Conference, Hyatt Regency Bethesda, Bethesda, MD, October 18-19
ASDC Annual Meeting, Registry Resort, Naples, FL, October 22-26.

1998

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

CHILD ABUSE

Child abusers, the abused, and the murdered: In our nation and your state

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

"An estimated 18.6% of inmates serving time in state prisons in 1991 for violent crimes, or about 61,000 offenders nationwide, had been convicted of a crime against a victim under age 18."[1]

"Two-thirds of all (state) prisoners convicted of rape or sexual assault had committed their crime against a child."[1]

"... 12.1 million women have been the victims of forcible rape ..."[2] "... 39% were raped more than once ... 3.0% at age 3 and under; 4.5% at age 4; 9.0% at age 5; ... 60% before they were 18 years old ..."[3]

Most presentations warning pediatric dental practitioners about the physical and psychological abuse of children emphasize the tragedy visited upon the victims, with particular attention to the fact that "... even patients who are less than ten or five years of age, and those who come from the 'best of families,' may have been abused and molested."[4] For example, a previous presentation (reviewing these tragedies through the mid-1980s) in the *Journal of Dentistry for Children* ended with the commentary that, "we need to do something to address the 6,000 kids who are neglected and abused every day."[4,5]

Available information (for the 1990s) from various federal agencies now provides further insight about those who perpetrate these acts, as well as an update on the youngsters who have been neglected, abused and murdered.

Dr. H. Barry Waldman is Professor, Dental Health Services, Department of General Dentistry, State University of New York at Stony Brook, Stony Brook, NY 11794-8706.

SOURCE OF DATA

The report on child victimizers represents the results from a series of personal interviews with a stratified random sample of prison inmates. The 1991 survey was conducted by the Bureau of the Census for the Bureau of Justice Statistics of the U.S. Department of Justice.[1]

The report on child abuse and neglect is based on material (required by the Federal Child Abuse, Prevention and Treatment Act) provided by states to the National Center on Child Abuse and Neglect of the Department of Health and Human Services. There are some differences by state in the reporting of this information. As a result, data in some categories in this presentation do not cover all states.[6]

PRISON INMATES WHO HAD VICTIMIZED CHILDREN

More than half of violent victimizers of children had victims age twelve or younger. When the victims were younger, the offender was more likely to have been convicted of child abuse, lewd acts, statutory rape or sodomy. Older child victims were more often reported by those convicted of forcible rape, robbery or assault. While victimizers of children accounted for 9.2 percent of all state prison inmates, they represented 39 percent of all inmates serving time for forcible rape, 85 percent of those serving time for sodomy, and 71 percent of those serving time for various other sexual assaults (Table 1).

Inmates convicted of violence against children were more likely to have been white, to have never been mar-

ried, and to have been older than offenders who victimized adults (Table 2).

Less than 10 percent of inmates serving prison time for rape or sexual assault of a child reported that the victim had been unknown to them. Three out of four child victims of child offenders were female and nearly one-third were the offender's own child or stepchild. Child victimizers in prison were more likely than violent offenders against adults to have committed the crime in their own home or the home of their victim.

- ☐ Violent offenders of children reported less involvement than adult victimizers with drugs or alcohol at the time of the crime.
- ☐ About six in ten offenders who victimized children have been sentenced previously to probation or incarceration, and one in four had a history of violence. Among inmates who committed their violent crime against a child, three in ten reported having victimized more than one child (Table 3).

While the news media tend to dramatize the repeated arrests of child molesters, in reality, those inmates who prey on adults tend to have more extensive arrest records. About one-half of those inmates, who committed their current offense against a child, had been arrested once before or had never been arrested. By contrast, about two-thirds of those with adult victims had more extensive arrest histories (Table 4).

- ☐ Offenders serving time for crimes against children were more likely to have grown up in homes with both parents present and to have suffered sexual abuse as a child.
- ☐ The median prison sentence imposed for child rape and sexual assault was shorter for child victims than for adult victims. The reason for sentencing differences may stem from a wide variety of factors associated with the offense and the offender, including whether weapons were used, whether the victim suffered injury or whether the offender had a police record. The median sentence for violent crimes against children in the 1991 study was 360 months for murder and 180 months for rape.
- ☐ Violent offenders of children were more likely than violent offenders of an adult to have special sentencing requirements to participate in a sex offenders treatment program or in psychiatric or psychological counseling.[1]

THE MURDER OF CHILDREN

The number of child murders has been growing since the mid-1980s, with the increasing concentration in the group between fifteen and seventeen years. Between 1976

Table 1 ☐ Offense distribution of state prisoners whose victims were under age 18: 1991.[1]

Offense	Child victimizers		Percent with victims less than age 13	Percent of all prisoners
	Number	Percent		
Violent offenses	61,037	93.7%	55.2%	18.6%
Homicide				
Murder	4,677	7.2	48.7	6.3
Negligent manslaughter	1,115	1.7	65.2	8.7
Kidnapping	1,508	2.3	45.2	18.0
Rape and sexual assault				
Forcible rape	8,908	13.7	43.7	39.1
Forcible sodomy	1,741	2.7	60.1	85.5
Statutory rape	1,102	1.7	62.1	94.8
Lewd acts with children	10,799	16.6	69.2	100.0
Other sexual assault	21,002	32.2	59.0	70.7
Robbery	3,772	5.8	28.7	3.6
Assault	6,058	9.3	53.3	10.2
Other violent acts	355	.5	76.7	16.0
Nonviolent offenses	4,126	6.3		1.1
All offenses	65,163	100%		9.2%

Table 2 ☐ Demographic characteristics of violent offenders of children: 1991.[1]

Gender	Percent
Male	96.6%
Female	3.4
Race	
White	69.7
African-American	25.5
Other	4.8
Hispanic-origin*	11.1
Marital status	
Married	23.3
Widowed	2.0
Divorced	32.7
Separated	5.4
Never married	36.5
Age at arrest	
< 18	2.1
18–24	26.1
25–29	17.6
30–34	16.9
35–39	12.0
40–49	14.1
50 +	11.2
Mean age at arrest	33 years
Median age at arrest	31 years

*May be of any race

Table 3 ☐ Estimated number of victims reported by child victimizers in state prison: 1991.[1]

Number of victims reported by prisoner	Estimated number of victims	
	< 13 yrs	< 18 yrs
Total	53,843	94,510
1	22,656	42,769
2	10,596	18,424
3	9,879	12,972
4+	10,712	20,345

Table 4 ☐ Criminal history of violent offenders by age of victim: 1991.[1]

Number of prior arrests as an adult or juvenile	Child victims	Victims of other ages
None	32.3%	18.9%
1	19.3	15.8
2	14.0	14.9
3	7.6	11.6
4	7.0	7.9
5	3.7	6.1
6–9	6.8	9.3
10+	9.3	15.5

and 1994, approximately 37,000 children were murdered (almost 19,000 white children and 17,000 African-American children—with younger offenders increasingly involved in these murders). Compared to the period between 1976 and 1994, in 1994 the percent of all murder victims who were less than eighteen years of age increased in thirty-seven states and the District of Columbia (Table 5). (Note: the number of murder victims is based on Federal Bureau of Investigation reports.[1] These reports do not specify, or necessarily include, the number of deaths of children resulting from abuse and/or neglect. See below).

- ☐ In the mid-1990s, one-half of the children murdered were killed with a handgun (a sharp increase after the mid-1980s when one-quarter of child murders were committed with a gun).
- ☐ Between the mid-1980s and 1993, the number of child murders increased by 94 percent. There was a slight decrease in the number of children murdered between 1993 and 1994 (Table 6).
- ☐ In the last ten years, the number of white murder victims between fifteen and seventeen years of age increased by 108 percent (from 287 to 597 murders), compared to a 249 percent increase in the number of African-American murder victims of the same age (from 245 to 855 murders).

In 1994:

- ☐ More than 2,500 children were murdered (about seven children per day).
- ☐ 11.4 percent of all murder victims were less than eighteen years of age (Table 5).
- ☐ The per capita murder rate for fifteen-to-seventeen-year-old white children was 6.3 per 100,000 population, compared to 49.3 per 100,000 African-American children.
- ☐ Over 70 percent of the murders of infants was done by a family member.[1]

MURDER RATES ARE NOT UNIFORM THROUGHOUT THE COUNTRY

In only three states (North Dakota, Vermont and Wyoming) were there no murders of children in 1994. During the same year:

- ☐ The number of children murdered ranged from one child in Delaware, Hawaii, Nebraska and South Dakota, to more than 100 in Florida, Illinois and New York, more than 200 in Texas and more than 400 in California.
- ☐ The number of children murdered per 100,000 population was almost four times higher in the District of Columbia (25.2 per 100,000) than in any state.
- ☐ In nine states (Idaho, Illinois, Iowa, Maine, Missouri, New Jersey, Utah, Washington, and Wisconsin) the murder of children represented 15 percent or more of all murders.
- ☐ The highest state per capita child murder rates occurred in Illinois (6.5 per 100,000 children), Missouri (5.8 per 100,000 children), California (5.5 per 100,000 children) and Louisiana (5.3 per 100,000 children). These states accounted for 19 percent of all children living in reporting states, but almost one-third (32 percent) of child murder victims in 1994 (Table 5).

ABUSE, NEGLECT AND DEATH OF CHILDREN

Between 1990 and 1994, there were 9.3 million child abuse incident reports of alleged maltreatment referred for investigation (2.5 million in 1990, 2.9 million in 1994, 43 per 1,000 children in each of the last three years). One-third (32.9 percent) of the cases were substantiated, and in an additional 7.7 percent of the cases there was

Table 5 ☐ Child murder victims by state: 1976–94.[1]

	Child murder victims				
	Number < 18 years		Percent of all murder victims who were < age 18		Number per 100,000 pop.
	1976-1994	1994	1976-1994	1994	1994
Alabama	493	47	6.1%	9.4%	4.4
Alaska	99	4	11.1	10.8	2.1
Arizona	518	56	10.5	13.4	4.9
Arkansas	315	23	8.1	7.8	3.6
California	5,977	473	10.2	12.7	5.5
Colorado	424	22	12.1	12.4	2.3
Connecticut	338	26	12.0	12.0	3.3
Delaware	65	1	11.2	7.7	0.6
Dist. Columbia	368	30	7.0	7.5	25.2
Florida	1,231	125	6.8	10.6	3.8
Georgia	756	70	6.7	10.3	3.7
Hawaii	82	1	8.6	2.0	0.3
Idaho	92	9	14.4	22.5	2.7
Illinois	2,019	199	11.4	16.9	6.5
Indiana	567	41	9.6	10.8	2.8
Iowa	135	7	14.3	15.9	1.0
Kansas	220	na	11.0	na	na
Kentucky	311	6	6.8	7.1	0.6
Louisiana	792	66	7.4	8.0	5.3
Maine	60	5	13.1	18.5	1.6
Maryland	799	56	9.5	9.7	4.4
Massachusetts	416	26	11.7	12.8	1.8
Michigan	1,751	89	9.9	10.0	3.5
Minnesota	271	20	14.3	13.8	1.5
Mississippi	251	24	6.8	10.5	3.2
Missouri	851	80	10.1	15.0	5.8
Montana	38	na	11.4	na	na
Nebraska	118	1	14.8	6.7	0.2
Nevada	148	15	7.1	8.9	4.0
New Hampshire	67	2	16.4	13.3	0.7
New Jersey	965	62	12.1	15.7	3.2
New Mexico	187	11	9.7	10.3	2.2
New York	3,235	193	8.8	9.7	4.3
North Carolina	710	61	6.3	8.1	3.5
North Dakota	23	0	14.9	0.0	0.0
Ohio	1,165	70	9.6	11.7	2.5
Oklahoma	468	31	10.0	13.7	3.5
Oregon	277	10	11.4	6.7	1.3
Pennsylvania	1,392	97	11.0	13.9	3.3
Rhode Island	76	2	11.0	4.9	0.8
South Carolina	423	40	6.6	11.3	4.2
South Dakota	38	1	18.8	11.1	0.5
Tennessee	399	42	5.3	10.0	3.2
Texas	3,015	224	7.6	11.1	4.2
Utah	167	11	17.5	17.2	1.6
Vermont	19	0	10.5	0.0	0.0
Virginia	762	54	8.5	9.4	3.4
Washington	487	45	12.1	15.4	3.2
West Virginia	140	5	6.9	5.1	1.2
Wisconsin	431	39	14.1	17.3	2.9
Wyoming	53	0	12.7	0.0	0.0
Total U.S.	34,005*	2,521**	9.1	11.4%	3.8

*Does not include an estimated 2,946 child victims for whom reports were not received, and a percent of 6,238 victims for whom ages were unknown.
**Does not include a percent of 384 victims for whom ages were unknown and 1,144 victims with inadequate reported data.

Table 6 ☐ Number of murdered children reported to police and percent killed with a gun: selected years 1976–1994.[1]

Year	Number killed	Percent killed with a gun
1976	1,629	28.5%
1980	1,813	29.6
1985	1,573	29.0
1990	2,295	41.7
1993	2,841	49.9
1994	2,660	47.6

Table 7 ☐ Source of reports of child maltreatment: 1990–1994.[6]

Professional		Nonprofessional	
Source	Percent	Source	Percent
Educator	15.8%	Anonymous/unknown	10.3%
Law/justice	12.0	Other relatives	10.1
Social Service	12.0	Others	8.7
Medical	10.7	Victim	1.6
Child care	1.6	Perpetrators	0.5

Table 8 ☐ Distribution of abuse and/or neglect perpetrators: 1994.[6]

Perpetrators	Percent
Parents	79.2%
Other relatives	9.2
Child providers	1.3
Facility staff	0.4
Foster parents	0.6
Non-caretaker	4.7
Others	0.8
Unknown	3.8
Total	100.0%

Table 9 ☐ Distribution and rate of maltreatment of children by race and Hispanic origin: 1990–1994.[1]

	Percent	Rate per 1,000 children
White	56%	11
African-American	27	25
Hispanic	10	10
Native American	1	na
Asian/Pacific Isl.	1	4
Unknown	4	na
Total	100%	

reason to suspect maltreatment but insufficient evidence to substantiate the allegation.

Most reports of allegations of maltreatment were by educators, law enforcement personnel, social workers and health practitioners. Rarely is the child victim the source of the allegation (Table 7).

In the overwhelming number of cases, the child's parents were the perpetrators of the abuse and/or neglect (79.2 percent) (Table 8).

- ☐ As the age of the child increased, the number of victims per 1,000 children decreased (sixteen victims per 1,000 children less than one year of age, nine victims per 1,000 children by sixteen years of age).
- ☐ More than half (53 percent) of substantiated cases of maltreatment were for neglect, 26 percent for physical abuse, 14 percent for sexual abuse and 5 percent for emotional maltreatment.
- ☐ Although white children represented more than half (56 percent) of all victimized children, the rate of African-American child maltreatment (twenty-five per 1,000 children) was more than double the rate of other populations (Table 9).
- ☐ Between 1990 and 1994, 5,400 children were known to have died from abuse or neglect (including 1,111 in 1994).[6]

VICTIMIZING CHILDREN IS NOT UNIFORM THROUGHOUT THE COUNTRY

In 1994, there were almost 1.2 million substantiated cases of children who had been maltreated (i.e. physical abuse, neglect, sexual abuse, medical neglect, emotional maltreatment). The number of maltreated children ranged from less than three thousand in Delaware, New Hampshire, South Dakota, Vermont, and Wyoming, to more than 60,000 in Florida, Georgia, Illinois, Ohio, and Texas, and more than 100,000 in California and New York.

Between 1990 and 1994, nationally, there was a one-third increase in the number of substantiated cases of maltreatment of children, but with marked variations by state. In the District of Columbia and thirteen states there were decreases in the number of cases (including greater than a 50 percent decrease in the District of Columbia, Massachusetts, New Jersey, and South Dakota). By contrast, there was more than a 100 percent increase in California, Georgia, and Oklahoma, more than a 200 percent increase in Idaho, more than a 300 percent increase in Arkansas, and more than a 400 percent increase in New Mexico (Table 10).

- ☐ In 1994, more than 600,000 parents were identified (by state) as being involved in child maltreatment

Table 10 ☐ Substantiated number of maltreated children, percent change, number of parents in maltreatment cases: 1990–1994.[6,7]

	Maltreated children		
	Substantiated number (1994)	Percent change 1990–94	Number of parents involved in maltreatment cases (1994)
Alabama	24,193	18.5	na
Alaska	7,351	47.8	5,519
Arizona	29,550	21.9	na
Arkansas	45,690	314.1	1,110
California	159,031	102.5	na
Colorado	9,543	−3.7*	4,989
Connecticut	20,637	55.9	22,624
Delaware	2,542	24.6	1,726
Dist. Columbia	5,636	−53.7	na
Florida	88,306	−9.3	16,669
Georgia	63,721	145.6*	31,844
Hawaii	3,872	49.5	2,574
Idaho	9,461	229.4	1,525
Illinois	60,520	44.8	26,404
Indiana	25,343	−5.5	24,253
Iowa	9,676	14.6	7,047
Kansas	3,644	33.2**	2,047
Kentucky	27,201	17.4	23,925
Louisiana	15,015	−2.4	10,685
Maine	4,769	5.6	na
Maryland	na	na	na
Massachusetts	29,927	−66.3	59,631
Michigan	23,026	−13.8	13,170
Minnesota	11,201	5.5	9,084
Mississippi	7,730	1.9	3,940
Missouri	20,401	−10.7	20,391
Montana	4,140	−36.1**	3,474
Nebraska	4,753	−18.9	5,404
Nevada	10,626	1.3**	9,851
New Hampshire	1,269	20.2	460
New Jersey	9,519	−61.8	7,740
New Mexico	24,915	468.9	8,906
New York	100,209	8.6**	39,097
North Carolina	29,479	18.5	31,807
North Dakota	3,617	25.0	na
Ohio	62,984	18.0	na
Oklahoma	19,354	115.6	12,732
Oregon	10,670	3.7	5,218
Pennsylvania	7,196	11.5	4,214
Rhode Island	4,921	15.1	4,071
South Carolina	16,891	26.8	6,206
South Dakota	2,186	−56.2	1,537
Tennessee	12,175	−1.4	9,661
Texas	65,385	18.5	33,313
Utah	10,430	22.4	5,911
Vermont	1,366	−19.4	755
Virginia	22,574	29.5	9,592
Washington	42,644	30.3	36,468
West Virginia	na	na	na
Wisconsin	19,066	25.4	11,612
Wyoming	2,778	12.1	na
Total U.S.	1,197,133	33.9%	605,559

*Percent change between 1991 and 1994
**Percent change between 1992 and 1994
Notes: – Maltreatment includes: physical abuse, neglect, sexual abuse, medical neglect, emotional maltreatment.
– In 1990 there were 11,353 additional substantiated cases of child maltreatment in the armed services, 10,437 in 1992.
– Table totals do not include reports from some states, therefore they are not necessarily comparable to national totals cited in the text.
– Number of parents may include more than one parent per case.

cases, with more than 20,000 parents identified in Connecticut, Illinois, Indiana, Kentucky, and Missouri, more than 30,000 identified in Georgia, New York, North Carolina, Texas, and Washington, and almost 60,000 identified in Massachusetts (Table 10).

FROM THE PRACTITIONER'S PERSPECTIVE

Surely it is difficult to come to terms with the fact that the youngster you have been treating in your operatory may have been physically or sexually molested (or may have been murdered). But added to this seemingly incomprehensible reality is the fact that the very perpetrator may be the child's father, mother and just about any other relative or family friend.

"Take the experience of one woman whose boyfriend beat her newborn child to death in 1987. The baby was her seventh child. Since then, she has had six more, all born with cocaine in their systems and three with syphilis. The last four were born HIV-positive. Their mother abandoned three of them at the hospital. All are now in foster care. Society pays at least $250,000 a year to care for them."[8]

As students and practitioners we are taught and learn to recognize the physical signs and symptoms of abuse. Unfortunately, the long-term emotional consequences of these unbelievable acts can be far more complex and may be beyond the training and capabilities of many pediatric dentists to diagnose and evaluate. What we interpret as a difficult younger dental patient "acting up," may be the child's response as we enter "their personal space" and "do things to their mouth" that to a young child may seem quite similar to those "other things" done by another friendly adult—maybe even a trusted relative or family friend.

If there is a lesson to be learned from a study of the abusers and the abused, it is that the occasional headline in the newspapers barely scratches the realities of this ongoing epidemic in each of our states and communities. The added dimension of the demographic characteristics of convicted perpetrators of these heinous acts, together with the reality that these unspeakable offenses occur in each of our states and communities, should alert health practitioners to the fact that seemingly caring family members can and often are involved in these events—and these happenings do occur "in the best of families!"

"It is much easier to cope successfully with behavioral problems, if the reason for the behavior is known. It is

much easier to show compassion and control of our own emotional reactions to another's behavior, if we can envisage the experience on which the other's behavior is predicated."[9]

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THE CHEERLESS CIRCUMSTANCES OF CHILDREN

Nearly one in five American children, and one in four children under six years of age, live in families with incomes below the poverty line. Indeed, nearly thirteen million children live in poverty—an increase of two million over those in poverty a decade ago. The number of these children who are unhealthy, malnourished, uneducated, and homeless also towers high. The United States ranks twenty-first in infant mortality rates among all nations for which statistics are known; this places the nation behind such countries as Singapore and Spain. According to parental reports, one in five American children between the ages of three and seventeen have experienced developmental delay, behavioral problems, or a learning disability. Currently, 8.3 million children lack any health insurance coverage. Risks of abuse or neglect by parents including exposure in utero to alcohol or illegal drugs reach record proportions. Children's own use of alcohol and illegal drugs produce immediate damage and correlate with violence. Large numbers of American children become parents as teens, drop out of schools, commit crimes, or commit suicide. Our society is now losing a wide band of children to early death, lengthy incarceration, joblessness, and hopelessness. Many children's childhoods are bleak, dangerous, and painful.

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PLAQUE

A comparison of plaque removal effectiveness of an electric versus a manual toothbrush in children

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Since the experiments of Loë *et al* it is generally accepted that dental plaque can be considered a direct cause of periodontal disease and chronic gingival inflammation.[1] It has also been shown, in studies in both adults and children, that a good control of dental plaque leads to a reduction of dental caries.[2,3] For the removal of dental plaque, toothbrushing is by far the most common method. The high prevalence of periodontal disease in the general population indicates, however, that toothbrushing performance is often inadequate.[4] Children are in this case no exception.[5] Extensive investigations showed that this group is generally not capable of obtaining a sufficient oral hygiene level by manual brushing, due to their not yet optimum motor skills, lack of knowledge about oral hygiene and effective brushing, the amount of time spent brushing their teeth or a combination of these efforts.[6-11]

Since the 1960s electric toothbrushes have been available to facilitate tooth cleaning and improve the oral hygiene level of consumers. Since then, numerous studies have been published investigating the effectiveness of these brushes on plaque removal and oral hygiene in adults. Although some reports indicate that electric and manual toothbrushes are equally effective, others, especially recent publications, show that modern electric brushes are superior.[12-19]

According to some investigators, powered toothbrushes are especially suited for people with reduced motor skills.[20-22] Children, in the stage of developing their gross and fine motor systems, can also be considered people with limited motor skills.

In previous studies the positive effect of electric toothbrushes on plaque control in children has indeed been reported.[23-25] It is remarkable, however, that after these early publications no recent studies on the subject have been reported. In this study we wanted to test the efficacy of a modern powered toothbrush by comparing the plaque reductions obtained with an electric brush and a manual brush in a group of school children. To allow for a translation of the clinical results to the home-use situation, no special (professional) instruction was given, neither to the participants, nor to the parents.

MATERIALS AND METHODS

Participants

From a dental practice twenty-four children, twelve male and twelve female, between five and ten years old, were included in the study. Children with orthodontic

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bands, large restorations, gross malocclusion or need for treatment of caries were excluded. All children were able to brush their own teeth and were in good general health. The children were assigned to two toothbrushing groups by randomized matching. The groups were matched for the variables of age and gender. Participants in one group were given the electric toothbrush, whereas participants in the second group received a manual toothbrush. Three of the participants in the first group had previous experience with a powered toothbrush. Before the start of the clinical trial, informed consent was obtained from each parent.

Brush design

In this study two brushes were used. The electric toothbrush (ET), Dental Logic HP550 (Philips Electronics, Eindhoven, The Netherlands) with the special attachment for children, containing twenty tufts for a total of approximately 1100 bristles, each with a thickness of 0.15 mm and a length of 8.7 mm. This toothbrush oscillates with a frequency of 70 Hz and a stroke of 2.0 mm in the longitudinal direction, combined with a low frequency (3 Hz) swing of $\pm 5°$ in the lateral direction. This brush is also equipped with a Soft Pressure System, which makes the brush head click back when too much (more than 330 g) force is used, thereby preventing excessive damage to the gingiva.

The manual toothbrush (MT), Butler Gum 111 (John O. Butler Co., Chicago, Ill. USA) especially for children, contains twenty-one tufts, arranged in rows of three tufts, with a total of approximately 920 bristles, and a thickness of 0.18 mm and a length of 9.2 mm.

Clinical procedures

At the first visit the children received their toothbrushes and were instructed to brush their teeth twice a day. They were told to brush in the evening for a period of two minutes; for the morning no desired brushing time was mentioned. To comply with the required two minutes, a timer was supplied. Except for an oral hygiene instruction brochure and the toothbrush manual for the ET group, no further instruction was given.[26] All subjects were given a normal abrasive dentifrice (Aquafresh Gel) and were instructed not to use other oral hygiene procedures (such as dental floss, toothpicks and water irrigating devices). Parents were told not to interfere with or correct the children's toothbrushing during the study.

Design of study

After approximately four weeks of home regimen the children returned to the clinic with their respective brushes. They were asked to abstain from oral hygiene procedures for at least twelve hours before examination. Using erythrosin as a disclosing solution, plaque was scored according to the Quigley and Hein index as modified by Turesky for both the buccal and lingual surfaces of all teeth.[27] Second molars, however, were not included in this study. Next, in the absence of this first examiner, the subjects brushed their teeth for two minutes with the assigned brush and dentifrice. During this procedure they were observed by a second examiner. No mirror was available for brushing, so the stained deposits could not be used as an aid for more effective cleansing. After brushing, the first examiner returned and reevaluated the amount of dental plaque remaining, following a second staining with erythrosin solution.

At the end the participants were asked whether they had a preference for the brush used in the study or for their usual brush.

Data analysis

Variations in the effectiveness of the two brushes were analyzed for different areas, such as the whole mouth, the lingual and buccal surfaces, and maxillary and mandibular arches. For each individual the average plaque score in each area was determined by summing the scores of teeth in that area and dividing the total by the number of teeth present. For the most detailed data analysis, however, the dentition was divided into twelve areas: for each arch the buccal or lingual surfaces of the posterior teeth (premolars and first molar) on each side, and the labial and lingual surfaces of anterior teeth (incisors and canines). For these smaller areas a similar data analysis procedure was used.

The difference between the scores before and after brushing for each individual was used as the variable to compare the effectiveness of the two toothbrushes. To this end, the reduction in terms of percentage of plaque scores was calculated for the areas investigated. The efficacy of both brushes was compared and tested, using Analysis of Variance (ANOVA). Observed differences with values of $p < 0.05$ were considered statistically significant.

Because a subject's hand preference might influence the brushing efficacy in the ipsilateral and contralateral areas of the mouth, the data for the left-handed subjects

were reversed, so data for their left side were analyzed with the right side data of right-handed subjects, and vice versa.

RESULTS

One subject in the MT group did not follow the given instructions and brushed in the evening significantly less than two minutes. This subject is excluded, therefore, from the study. The distribution of the remaining twenty-three participants over the two groups is presented in Table 1. As can be seen from this table, the exclusion of one subject from the MT group does not result in an imbalance in the two groups with respect to age or gender.

In Table 2 the mean prebrushing and postbrushing Turesky modified Quigley and Hein plaque scores for the entire group and for the MT and ET groups are given for the whole mouth, for the lingual and buccal surfaces, and for the maxillary and mandibular arches. All postbrushing data show a considerable reduction in plaque compared to the corresponding baseline data. For the whole mouth the ET group at baseline clearly shows a larger plaque score (2.23) than the MT group (2.03), the difference being almost significant ($p = 0.08$). After brushing, this situation is reversed, with the ET group having an almost significant ($p = 0.06$) lower plaque level (1.20) compared to the MT group. If the lingual and buccal surfaces are considered, it is clear that for the total group at baseline, the lingual surfaces show a considerably lower plaque score than the buccal surfaces, respectively 1.78 and 2.49. After brushing, this difference is reduced but, although smaller, remains present. A similar behavior is observed for the two selected groups. The maxillary and mandibular arches show at baseline a plaque score of respectively 2.00 and 2.27 for the total group. Especially the mandibular arch of the ET group is responsible for the higher score of this latter number. After brushing, both arches show a reduced plaque level, in which the score of the maxillary arch remains lowest.

For the areas presented in Table 2 the mean percentile of plaque reduction for both the MT and ET groups obtained after brushing for two minutes is calculated and shown in Table 3.

From this table it becomes clear that for all areas, plaque reduction in the ET group is significantly better than in the MT group. If the whole mouth is considered, plaque reduction using an electric brush is almost twice as high; if the lingual area is considered, it is almost three times as high. Although the difference for the buccal side is only 14 percent in the absolute sense, it is still highly significant.

From Table 3 it also becomes clear that the average plaque reduction with an electric brush in all areas presented is between 42 percent and 49 percent. If a manual brush is used, values are lower and show more variation: from 17 percent up to 32 percent. These data suggest that the use of an electric brush results in a more even reduction of dental plaque. To test this, the brushing results are examined in more detail and the plaque reductions for twelve areas of the mouth are determined. Results are given in Table 4. Here it is shown that for participants in the ET group most plaque is removed from the maxillary posterior teeth, from 49 percent up to 62 percent. The mandibular posterior teeth show a plaque reduction of about 45 percent, with the exception of the lingual left posterior area. Plaque reduction of all anterior teeth in this group is between 40

Table 1 ☐ Distribution of age, gender and dexterity of participants included in this study.

	Age (years)	Gender		Dexterity	
	mean age	male	female	right-handed	left-handed
Electric toothbrush	7.7	6	6	8	4
Manual toothbrush	7.9	6	5	10	1

Table 2 ☐ Turesky modified Quigley and Hein mean plaque index for the total group of participants and for the groups of children brushing manually (MT) and with an electric toothbrush (ET), before and after brushing for two minutes at the dental clinic. (SD) = standard deviation of original observations.

		Total group		MT group		ET group	
		plaque	(SD)	plaque	(SD)	plaque	(SD)
Whole mouth	Pre-brushing	2.13	(0.28)	2.03	(0.26)	2.23	(0.26)
	Post-brushing	1.34	(0.35)	1.48	(0.32)	1.20	(0.33)
Lingual	Pre-brushing	1.78	(0.33)	1.71	(0.30)	1.84	(0.36)
	Post-brushing	1.18	(0.36)	1.38	(0.24)	0.99	(0.35)
Buccal	Pre-brushing	2.49	(0.36)	2.35	(0.40)	2.61	(0.27)
	Post-brushing	1.50	(0.43)	1.58	(0.46)	1.42	(0.41)
Maxillary	Pre-brushing	2.00	(0.35)	1.98	(0.39)	2.01	(0.34)
	Post-brushing	1.18	(0.37)	1.35	(0.35)	1.02	(0.32)
Mandibular	Pre-brushing	2.27	(0.33)	2.08	(0.28)	2.44	(0.28)
	Post-brushing	1.50	(0.39)	1.61	(0.33)	1.39	(0.42)

Table 3 ☐ Comparison of the mean percentile plaque reduction obtained in the MT group and in the ET group after brushing for two minutes at the dental clinic.

	MT group	ET group
	plaque reduction	plaque reduction
Whole mouth	25%	46%°°°
Lingual	17%	47%°°°
Buccal	32%	46%°°°
Maxillary	28%	49%°°°
Mandibular	22%	42%°°°

°$p < 0.05$; °° $p < 0.01$; °°° $p < 0.001$.

Table 4 □ Comparison of the mean percentile plaque reduction obtained in the MT group and in the ET group after brushing for two minutes at the dental clinic.

			MT group plaque reduction	ET group plaque reduction
Maxillary	Buccal	Right posterior	35%	50%
		Anterior	37%	40%
		Left posterior	24%	51%°
	Lingual	Right posterior	29%	62%°°
		Anterior	24%	46%
		Left posterior	17%	49%°°
Mandibular	Buccal	Right posterior	29%	43%
		Anterior	34%	40%
		Left posterior	31%	44%
	Lingual	Right posterior	7%	46%°°°
		Anterior	20%	47%°
		Left posterior	7%	35%°

° $p < 0.05$; °° $p < 0.01$; °°° $p < 0.001$.

percent and 47 percent. In the manual group (MT) such clear patterns cannot be observed. For the maxillary arch results vary from 17 percent up to 37 percent. For the mandibular arch, the lingual sides of both the left and right posterior teeth show a reduction of only 7 percent. For the buccal sides this reduction is approximately 30 percent. Although in both groups the differences observed for the various areas remain large, it can indeed be concluded that children brushing with an electric brush show a more uniform cleaning of various parts of their dentitions. For the ET group the difference between the two extreme scores, the maxillary lingual right posterior area and the mandibular lingual left posterior area, is almost a factor of 2. For the MT group the difference between the lowest values, 7 percent for the mandibular lingual posterior areas, and the highest value for maxillary labial anterior teeth (37 percent) is more than a factor of 5.

For all these twelve areas children brushing with an electric brush remove more plaque than children brushing manually. If per area the results of the MT and ET groups are compared, it is seen that especially for the lingual surfaces of the posterior teeth significant differences are observed. With an exception of the maxillary buccal left posterior teeth the differences observed between the two groups for the buccal surfaces are not significant. Regarding the anterior teeth, only one of the four areas (mandibular lingual) shows a significant difference.

When the children brushed their teeth in the dental clinic the second examiner observed that almost all children in the ET group concentrated their brushing along both arches, without making additional movements. In the MT group, most children applied the scrubbing technique, making fast, short, horizontal strokes. The brush head of the electric brush, equipped with the Soft Pressure System, never clicked back, indicating that children in the ET group used a pressure that is less than 330'g. No comment can be made on the pressure used by the children brushing manually.

In the ET group, nine of the twelve participants used a manual brush before they participated in this study. At the end of this study six of these nine children preferred the electric brush compared to their previous manual toothbrush, two children had no preference and only one child preferred his previous manual brush.

DISCUSSION

This study demonstrates that for children the electric toothbrush tested is superior in controlling dental plaque to a good quality multitufted manual toothbrush. Since toothbrushes, over-the-counter products, are purchased in general without instruction for use, the design of this study, without professional instruction for both groups, is such that the results can be translated to a normal home-use situation.

When more time is spent on brushing, plaque removal by both manual and powered toothbrushes will be more efficient.[19,28] Since it is the aim of this study to compare the effectiveness of two toothbrushes, all participants were instructed to brush for the same fixed time. The brushing time in this study was standardized to two minutes, in accordance with previous studies.[12,19,29] It should be realized, however, that two minutes brushing is about twice as long as the usual brushing time reported for children in this age group.[11,30] If children brush for less than two minutes, the amount of plaque removed will probably be reduced. The conclusion that the electric brush is better in controlling plaque than the manual brush would probably still be valid, however, based on the results presented by Weijden *et al*, who showed that the differences between manual and electric brushes vary little, when the total brushing time is reduced from two minutes to one minute.[19]

The children participating in this study were between five years and ten years old. The upper limit was set in a trial preceding the study, in which the investigators noticed that children older than ten years no longer wanted to clean their teeth with a brush designed for children. The lower limit was established by the fact that children younger than five years do not have sufficient motor skills to clean their own teeth.[8] For this group it is advised that parents brush their children's teeth.[9] As a result only children between five and ten years old who brushed their own teeth participated in the study. Be-

cause children in this age group are developing their motor skills, special care was taken to balance the two groups with respect to age distribution.

At the beginning of this study two groups of children are formed, randomized with respect to age, gender and dexterity. Because at baseline the plaque levels of both groups generally will not be equal, the efficacy of both brushes in this study is tested by examining the mean percentile of plaque reduction after brushing for two minutes, instead of using the absolute values before and after brushing.

The results presented in Table 3 show that the Philips Dental Logic HP550 electric brush removes significantly more plaque than the Butler Gum 111 manual brush, if the whole mouth is considered: a mean percentile of plaque reduction of 46 percent compared to 25 percent. Highly significant effects are also observed if the results from the lingual and buccal surfaces, or from the maxillary and mandibular arches, are compared. Especially for the lingual surfaces, the difference of 47 percent plaque reduction in the ET group compared to 17 percent reduction in the MT group is remarkable. These results, for children brushing their own teeth, confirm the findings of Conroy *et al*, Hall *et al*, and Lefkowitz *et al*, who showed that children benefit from brushing with a powered toothbrush.[23-25]

Despite the fact that the electric brush performs superior to the manual brush, the average oral hygiene level in the ET group remains low (1.20 seen in Table 2). Such findings agree with results presented by Mack and Kipnis, and by Lefkowitz and Robinson, who discuss the poor oral hygiene level for this age-group.[5,25] In studies including adults and children, it was shown, however, that regular (professional) instruction and training can result in a substantially improved level of oral hygiene.[7,8,17,31]

Although the electric brush removes significantly more plaque than the manual brush, the ET group shows at baseline a higher plaque score than the MT group (Table 2), almost significant with $p < 0.08$. After brushing, the score for this group is lower than that for the MT group, also almost significant with $p < 0.06$, due to the superior performance of the electric toothbrush. Because at the examination participants already have used the assigned brush for a period of about four weeks, these results seem at first sight contradictory. An almost significant lower plaque score after brushing (for the ET group) results more than twelve hours later, according to our findings, in an almost significant higher plaque score. At the beginning of the trial the two groups were only randomized, however, with respect to age and gender. At that point no plaque scores were determined so the mean plaque score for the ET and MT groups at the beginning of the trial need not have been identical. It is possible, therefore, that subjects assigned to the ET group had an initial plaque level that was substantially higher than that of subjects belonging to the MT group. Such imbalance in the two groups could explain the observations for the entire mouth presented in Table 2.

In Table 2 it is also observed that at baseline, the plaque levels for the lingual areas are considerably lower than for the buccal areas; for the total group of participants these numbers are respectively 1.78 and 2.49 with $p < 0.001$. This observation agrees with those reported previously, in that children showed a much lower plaque level on the lingual areas before brushing.[6,23,24] Addy *et al* ascribed this effect to the natural cleaning action of the tongue.[6] After brushing, the lingual areas still have a lower plaque level compared to the buccal areas, with recordings for the total group of respectively 1.18 and 1.50 with $p < 0.01$. The observation that after brushing the lingual areas remain the cleanest areas is in agreement with findings by Conroy *et al* and Hall *et al*.[23,24] Especially in the MT group, however, plaque is reduced on the buccal areas considerably more than on the lingual areas (Table 3). This is in accordance with findings reported by Macgregor *et al*, Hall *et al*, and Korins *et al*, who state that the lingual areas are the areas least brushed by children.[10,24,32] It is remarkable, therefore, that the result observed by us for the ET group, where the reduction in the amount of plaque for both the lingual and buccal areas is similar (Table 3), and in both instances significantly more than for the MT group. We could speculate, therefore, that although generally the time spent on brushing the lingual areas is significantly less than the time spent on brushing the buccal areas, the electric brush is still capable of reducing the same amount of plaque on both sides.[11,33] A confirmation of this hypothesis could only be obtained, if also the brushing behavior of the participants in our study would have been analyzed in detail.

Table 2 shows that at baseline the plaque score for the maxillary arch (2.00) is lower than that for the mandibular arch (2.27) with $p < 0.05$, a result which is in agreement with that reported by Sarvia *et al*.[7] Other investigators report few differences, however, between maxillary and mandibular plaque levels.[6,23,24] The significant difference we observe can be completely accounted for by the mandibular plaque score of the ET group of 2.44. All other values for the two arches for the two subgroups are approximately 2.0. After brushing, the plaque levels again show a significant difference ($p <$

0.01) with a value of 1.18 for the maxillary arch and 1.50 for the mandibular arch. In both the MT and ET groups reduction for the maxillary arch is greater than for the mandibular arch (Table 3), albeit that the ET group shows a 20 percent absolute better plaque reduction than the MT group. A larger plaque reduction for the maxillary arch seems in contradiction with reports that generally children spent more time on brushing the mandibular arch.[11,33] Since a detailed analysis of the brushing behavior of our participants is lacking, no definite conclusions can be drawn.

A more detailed analysis of the differences between the performances of the manual and electric toothbrushes is possible, using the results shown in Table 4, where the data are presented for twelve different areas of the mouth. These data show that for all areas plaque reduction in the ET group is greater than in the MT group; but that, in contrast to the data shown in Table 3, here only for a few areas significant differences are observed. This effect can be accounted for by the reduced data available for the analysis of variance for each individual area. For all lingual areas of posterior teeth a significant difference is observed. These areas are reported to be brushed least by children.[34] For the MT group it is observed that indeed the lingual mandibular molars are hardly cleaned, in strong agreement with results reported by Korins *et al.*[32] Table 4 also shows that in this group the anterior teeth are brushed better than the posterior teeth, in accordance with observations by Hall and Conroy and Korins *et al.*[24,32] For the ET group such a result is not observed. Here the posterior teeth are cleaned better than the anterior teeth, especially for the maxillary arch. If the data for the left and right posterior teeth are considered, it is seen that the ipsilateral side of the mouth is cleaned slightly better than the contralateral side, although not significantly so. This finding is not in agreement with that by Rugg-Gunn and Macgregor, who showed that a greater portion of time is spent brushing the contralateral side.[11] Since the brushing behavior of the children in this study is not analyzed in detail, however, it is unclear whether our participants also spent more time on the contralateral side.

The most striking difference noted when observing the children brush their teeth was the MT group using the scrubbing technique, whereas children in the ET group guided the powered brush along the dental arch. As a result, the cleaning motion of the bristle hairs on the teeth itself will be substantially different for the two brushes. Since the brushing motion of the electric brush is automatic, it could also be easier for the children to concentrate on guiding the brush through the mouth. We consider, therefore, (supported by Park *et al*) the automatic brush motion to be the main reason for the differences in plaque removal between the manual and electric toothbrushes.[35] It should also be mentioned, that although nine of the twelve participants in the ET group had no previous experience with powered toothbrushes, none of these children had a problem in adapting to the electric brush. Similar observations are reported by Lefkowitz and Robinson.[25]

CONCLUSIONS

In conclusion this study clearly shows that the Philips Dental Logic HP550 toothbrush with the special attachment for children removes significantly more plaque than the Butler Gum 111 manual toothbrush, when used by children. This is observed for all areas of the mouth, but the differences are greatest for the posterior lingual areas. Moreover, the electric brush also results in a more evenly distributed plaque reduction. Children showed no problem in adapting to the electric brush.

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CHILDHOOD ABUSE AND THE USE OF INHALANTS

Since inhalant users have more extensive substance involvement than nonusers, the association between inhalant use and a history of child abuse may reflect a general relationship between child abuse and lifetime drug involvement. We note that our indicator of the total extent of lifetime drug involvement (number of noninhalant drugs besides alcohol reported in the life-history interview) was not directly associated with child abuse in the logistic regression. Further, the association between child abuse and heavy inhalant use persisted even after the extent of other drug use was controlled for in the regression model.

Models positing a causal role for child abuse in the etiology of inhalant use are also consistent with theories emphasizing the influence of weakened attachments to legitimate institutions at the onset of substance abuse (social control theory). Child abuse may perhaps be viewed as constituting an extreme form of parental rejection that may result in self-derogation, a weakening of attachments to family and school, and an increased association with drug-using peers. Researchers have demonstrated the importance of pathways leading to identification with drug-using peers in early-onset use of noninhalant substances and in the progression to higher levels of drug use.

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CLINIC

Initial tensile bond strength of resin-modified glass ionomers and polyacid-modified resins on perfused primary dentin

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Glass ionomer cements are well established in pediatric dentistry and have provided the clinician with a material that offers a greater choice of clinical alternatives for patients who require esthetic and mercury-free restorations.[1] As other investigators have emphasized, one of the advantages of this material group is its ability to bond to dental hard tissues. Bonding to cavity walls can reduce formation of marginal gaps and, moreover, allows the use of adhesive restorative materials, thus eliminating the need for undercuts or other macroretentive preparation techniques. Recently, new restorative materials containing both glass ionomer and composite resin components have been introduced.

According to McLean *et al* these materials may be classified as resin-modified glass ionomers (with a mainly acid-base reaction pattern) and polyacid-modified composite resins (with an acid-base reaction not capable of curing in the dark).[2] With the exception of selected clinical situations in the permanent dentition, these materials are usually recommended for restoration of primary teeth. There is only scanty information, however, about the adhesion of these materials to dental hard tissues.[3-5] In particular, this is true with regard to primary teeth.

The objective of this study was to evaluate the initial tensile bond strength of a resin-modified glass ionomer (Photac®-Fil) and two polyacid-modified composite resins (Compoglass®, Dyract™) to dentin of primary teeth. A hybrid composite (Tetric®) and two chemically cured glass ionomers (BaseLine®, Hi-Dense®) served as control groups.

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MATERIALS AND METHODS

Preparation of dentin specimens

Ninety primary first and second molars, stored in Ringer's solution at room temperature, were used within one month after extraction. The teeth were extracted from extremely uncooperative or handicapped children (ages four to seven years) during treatment using general anesthesia. All teeth were removed because of extensive caries and with the informed consent of the parents.

Initially, the roots were severed with a water-cooled diamond saw at a level approximately 1 mm below the cementoenamel junction. Pulpal tissue remnants were carefully removed without touching the walls of the pulp chamber. Enamel and dentin reductions followed on noncarious and intact regions, using a high-speed handpiece under copious water spray. Care was taken to ensure that a sound tooth surface with a diameter of at least 6 mm was available for testing the quality of an adhesion. Then surfaces were ground flat (800-grit) with a polishing machine (Jean Wirtz Laboratoriumseinrichtungen; Düsseldorf, Germany) under a continuous

stream of running water. The countersides were reduced without touching the pulpal bulge, parallel to the established flat plane. The remaining surface-to-pulp dentinal thickness amounted to 1 mm. Subsequently, the tooth specimens were mounted to a perfusor filled with Ringer's solution, and remained under hydrostatic pressure of 30 cm H_2O for at least 30 min (Figure 1).

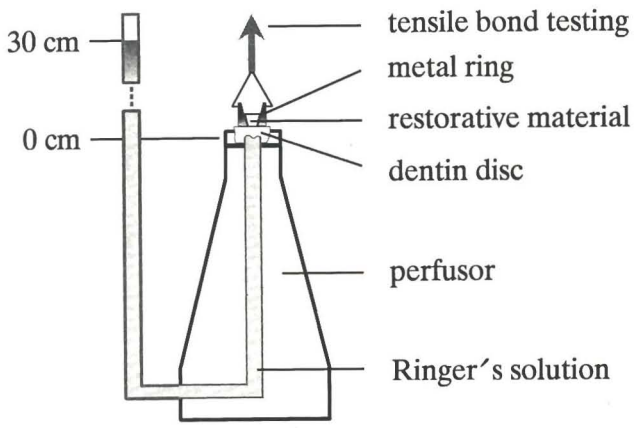

Figure 1. Schematic diagram of the experimental design.

Application of restorative materials

The specimens were randomly divided into six groups of fifteen, according to the restorative materials used in this study (Table). The tooth surfaces were dried with oil-free compressed air. Pretreatment of the dentin followed, using the dentin bonding system recommended for the respective materials, except for BaseLine®, which was used without conditioner. Application procedure of the pretreatment agents was performed according to the manufacturers instructions (Table). Ninety metal rings (stainless steel) with identical dimensions (internal diameter of 3 mm, external diameter of 6 mm, with a conical angle of 6°, and a height of 4 mm) were used as standardized "cavities". The metal ring was placed on the dentinal surface, and the respective restorative material was applied. The light-cured materials were inserted in a two-step incremental technique of approximately 1.5 mm each (Figure 1). For the respective increments, photocuring lasted for 1 min (Heliomat, Vivadent; Ellwangen, Germany; 300 mw/cm^2). The chemically cured glass ionomers were inserted in the metal rings in a one-step bulk (approximately 3 mm). HiDense® additionally was condensed. Then the two chemically cured materials were allowed to set (5 min), followed by covering with wax.

Evaluation of tensile bond strength and statistical analysis

Fifteen minutes after curing, tensile bond strength (TBS) of the respective specimens was tested with a uni-

Table ☐ Material systems tested.

Classification	Restorative material	Dentin pretreatment	Composition of dentin conditioner
Chemically cured glass ionomer	BaseLine® #9311108/B2 (DeTrey/Dentsply; Konstanz, Germany)	no conditioning	
Chemically cured glass ionomer	Hi-Dense® (Shofu; Ratingen, Germany)	Hi-Tooth® Cleanser #1092065 applied (10 sec), washed off (30 sec), dried with air	polyacrylic acid (25%)
Resin-modified glass ionomer	Photac®-Fil #027/A3U (Espe; Seefeld, Germany)	Ketac® Conditioner #00612376 applied (10 sec), washed off (30 sec), dried with air	polyacrylic acid (25%)
Polyacid-modified composite resin	Compoglass® #708535/A3,5 (Vivadent; Ellwangen, Germany)	Compoglass® SCA #716109 applied two times (20 sec), light cured (20 sec each)	HEMA, polyacrylic acid, maleic acid, water
Polyacid-modified composite resin	Dyract™ #9502141/A4 (DeTrey/Dentsply; Konstanz, Germany)	Dyract®-PSA Prime/Adhesive #9502111Z applied two times (10 sec), light cured (10 sec each)	TEGDMA, PENTA, acetone
Hybrid composite resin	Tetric® #711544/A3 (Vivadent; Ellwangen, Germany)	1. Syntac® Primer, #708786 applied for 15 sec, dried with air 2. Syntac® Adhesive, #713313 applied for 10 sec, dried with air 3. Heliobond®, #709349 application of thin layer, light cured for 10 sec	TEGDMA, maleic acid PEGDMA, glutaraldehyde Bis-GMA, TEGDMA

versal testing machine (Zwick 1445, Zwick; Ulm, Germany) running at a crosshead speed of 5 mm/min (Figure 1). The dentinal discs with the cured restorative materials were mounted perpendicular to the moving crosshead of the testing machine, in a distance of 80 cm to ensure loading in accordance with a straight axis. For this purpose the crosshead was linked with the metal ring by a chain. TBS values were recorded in units of megapascals (MPa). Repeated-measurements ANOVA, followed by closed test procedure (based on Kruskal-Wallis) were used to evaluate for significance of the results (SAS-PC Release 6.09). The level of significance was set at 5 percent.

RESULTS

Mean tensile bond strength for each material group is presented in Figure 1. The highest dentin bond strength was observed with the hybrid composite resin Tetric® ($x = 5.17$ MPa). This was significantly different ($P < 0.05$) from the polyacid-modified composite resins Dyract™ (2.35 MPa) and Compoglass® (1.82 MPa), which revealed comparable bond strengths. Regarding the chemically cured condensable glass ionomer Hi-Dense®, a mean tensile bond strength of 0.79 MPa was found. Closed test procedure revealed a significant difference ($P < 0.05$) when compared with the polyacid-modified composite resins, with the resin-modified glass ionomer Photac®-Fil, and with the chemically cured glass ionomer BaseLine®. There was no statistically significant difference in mean tensile bond strength between Photac®-Fil (0.42 MPa) and BaseLine® (0.37 MPa).

DISCUSSION

Low bond strength can contribute to inadequate bonding and wider marginal gaps.[3] Leakage is responsible for marginal discoloration; postoperative sensitivity; bacterial penetration, leading to secondary caries; and pulpal inflammation. For these reasons, tight bonding of restorative materials to enamel and dentin is worthwhile. This is particularly important in children, who frequently put filling materials to the test as soon as they have been placed.

Regarding the resin bonding systems using hydrophilic monomers, several adhesive concepts have been proposed. Depending on the specific characteristics of the various bonding agents, smear layer will be removed, penetrated, or solubilized. Furthermore, the exposed dentin can be demineralized. In the latter case bonding

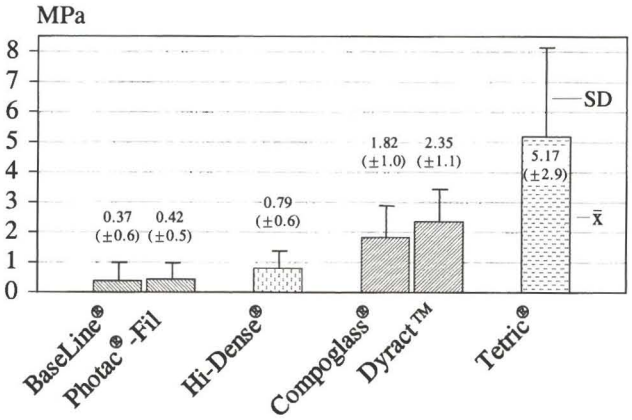

Figure 2. Means and standard deviations (±SD in MPa) of dentin tensile bond strengths of the tested materials. Bars with different hatching indicated significant differences ($p < 0.05$).

to dentin is established by tag formation in the dentinal tubules of etched dentin, and by creating a hybrid layer of resin-reinforced dentin.[3,6,7] This mechanical bond can be completed by chemical and mechanical bonding to precipitates on pretreated dentinal substrate, or to either inorganic or organic components of the dentin.

The present study was performed on noncarious dentin of primary teeth. In order to simulate the clinical situation, the dentin was perfused with Ringer's solution. Recent papers focusing on dentin bond strengths of light-cured glass ionomer materials or composite resins, pointed out that adhesion values were somewhat higher than those observed in the present investigation.[8-12] Most of the former studies were performed on more or less dry dentin samples, however, and not on perfused ones. This could explain the present findings. Furthermore, this idea is supported in recent papers suggesting that decreased pulpal pressure, and thus a reduced presence of moisture results in increased dentin bond strengths.[13,14] Moisture effects on adhesion strongly depend, however, on the respective bonding system used.[15] Even though the permeability of primary teeth is significantly lower, if compared with permanent teeth, perfusion of the dentin supposedly contributed to the comparably low bond strengths observed in the present study.

Moreover, there are some anatomical reasons for the reduced bond strengths on primary dentin. For primary teeth, the peritubular dentin is two- to five-times thicker than in the permanent dentition.[17] Since the peritubular dentin has a greater mineral content than the intertubular dentin, any bonding of the adhesive could be af-

fected. Due to the fact that the intertubular dentin content of primary dentin is less than in permanent teeth, the formation of a hybrid layer could be affected, thus resulting in decreased bond strengths.[18] This could be the reason for the significantly lower bond strengths of some adhesive systems to primary dentin, if compared to dentin of permanent teeth.[11,19,20] Indeed, the present study revealed a definitely lower degree of adhesion of the hybrid composite, when compared with a recent investigation using similar methods and the same materials involving dentin of permanent teeth.[21] Regarding the polyacid-modified composite resins, the low degree of adhesion probably is caused by the missing hybrid layer and the decreased formation of tags. A recent qualitative study using scanning electron microscopy demonstrated a thin adhesive resin layer (without formation of a hybrid layer), and partly open dentinal tubules after use of polyacid-modified composite resins.[22] Thus it can be assumed for the present that the failure after the use of these materials occurred mainly at the interface.

Without exception the primary molars used in the present study came from young children. It might be possible that the tubules of the dentin specimens were less patent, because the teeth from which they were cut were carious.[23] This would contribute to an increased thickness of the peritubular dentin, resulting in an increased resistance to conditioning agents. At the same time, penetration of the resin would be hampered. Concerning the chemically cured glass ionomers, using polyacrylic acid as dentin conditioner, adhesion to primary dentin resulted in very low bond strengths. This is in accordance with an earlier study, where comparably low values have been reported.[24] The low bond strengths of glass ionomers to primary dentin have been explained by the lower mineralization levels of primary teeth, compared to the permanent dentition.[24] Thus ionic and polar forces between primary dentin and the cement might be weak and chemical adhesion to dentin could be decreased. The application of BaseLine®, which was used without conditioning agent in the present study, resulted in the lowest overall bond strengths. It can be assumed that these specimens fractured at the smear layer, which was significant because of the preparation technique used in this study.[3] Differences between the etchability of the smear layers created with different methods have been pointed out recently.[15] Nevertheless, the resin-modified glass ionomer Photac®-Fil and the condensable glass ionomer Hi-Dense® did not reach the bond strengths of the polyacid-modified composite resins as well, suggesting that in primary teeth the use of polyacrylic acid as conditioning agent is not superior to the use of hydrophilic monomers. It should be emphasized, however, that chemically cured glass ionomer cements take 24 h to complete their setting reaction. Thus, the chemically cured materials used in this study did not reach their final set, and it can be assumed that this fact might have contributed to the low adhesion values.

The findings presented here are obviously of clinical significance, since they demonstrate the difficulties in establishing a strong bond between restorative materials and primary dentin. Concerning the clinical situation, several conditions influence the selection of the appropriate material. In addition to some material factors (e.g. abrasion, elasticity, fluoride release, microleakage), other prevailing circumstances (like dentin factors, tooth factors, and patient factors) should be taken into consideration. Regarding the observed initial bond strengths, however, macroretentive preparation techniques in primary teeth should continue to receive our attention.

The following conclusions can be drawn from the present investigation:

- ☐ Within the limitations of an *in vitro* study, adhesion of (polyacid-modified) composite resins and (resin-modified) glass ionomers to dentin of primary teeth is low.
- ☐ The use of hydrophilic monomers as dentin bonding agents is superior to polyacrylic acid as a dentin conditioning agent.

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PRACTICING MEDICINE WITHOUT A LICENSE

Something new is happening in Washington: Congress is practicing medicine. In recent months, Congress overwhelmingly passed legislation forcing health plans to pay for 48-hour hospital stays for women delivering babies, passed a resolution promoting mammography for women in their forties, and passed a bill outlawing abortions by intact dilation and extraction ("partial-birth abortions").

How far should Congress go in intruding into specific medical practices? The era of physicians' monopoly of medical facts and practices is over, and well it should be. Medical imperialism is obsolete. Physicians should no more have exclusive dominion over medical information and decisions than attorneys should have control over the facts and practices of the law. In an era of abundantly available medical information, open discussion of medical issues is appropriate for all interested parties, and even promises to improve medical care.

Obviously, the government already has a substantial role in regulating medical practice. The Food and Drug Administration is a prime example. With the exception of a small band of libertarians who advocate a laissez-faire approach to the use of drugs and devices, most of us believe that there is a legitimate role for government in this kind of regulation. But regulation by the FDA is based on carefully evaluated scientific judgments by experts and is shielded from direct intrusion by legislators. Similarly, NCI advisory panels base their decisions on hard scientific evidence.

The issue is neither the control of medical decisions by the medical profession nor the expanding role of patients; it is whether such decisions should be made by politicians. I believe that Congress is not the appropriate forum for making complex medical decisions. The data upon which many important medical decisions are based are often contradictory and still in evolution. Legislators do not have the context nor the capacity to weigh medical evidence adequately.

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Alveolar bone height of primary and first permanent molars in healthy seven- to nine-year-old children

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Elizabeth Allred, MS
W. Kim Seow, BDS, MDSc, DDSc, PhD

Numerous clinical and radiographic studies have documented that alveolar bone loss occurs in both children and adolescents, thus periodontal disease is not limited to gingival morbidity in these age-groups.[1–16] This is also supported by findings that apical migration of the junctional epithelium occurs on primary teeth.[17–20] In 1991 Bimstein hypothesized that children with incipient periodontal diseases may become adults with advanced periodontal diseases, and that periodontal disease in primary teeth may facilitate the establishment of periodontal diseases in the adjacent permanent teeth.[18] Periodontal disease in children may indicate the presence of predisposing factors that can facilitate the establishment of disease at subsequent ages and may also be associated with systemic diseases.[20–22] These include hypophosphatasia, leukocyte adhesion deficiency, neutropenia, Papillon-Lefevre syndrome, histiocytosis, and insulin-dependent diabetes mellitus.[20,22–24]

There is a wide variation in the reported prevalence of periodontitis in children and adolescents ranging from 0 percent to 51.5 percent.[2,4] These disparate results may be due to the use of subjects of different ethnic backgrounds, ages, and/or stages of dentition. In addition, these studies used a wide variety of diagnostic criteria to determine periodontitis. Some investigators relied on clinical measurements of attachment loss, while others used radiographic evidence of bone loss $\tau 2$ mm.[5,7,12,14–16,25–28]

Only a few studies done primarily on Israeli and Scandinavian children have attempted to determine the normal values for the distances between the cementoenamel junction (CEJ) and alveolar crest (AC) in the primary dentition of healthy children.[25–28] The purpose of the present study was to investigate and establish baseline values of the alveolar bone height of primary and first permanent molars using direct measurements on standardized radiographs in a sample of healthy U.S., seven to nine-year-old children. In addition, this study investigated whether alveolar bone height varied as a function of age, gender, dental arch, position within the arch, interproximal contact, interproximal caries, or the presence of restorations.

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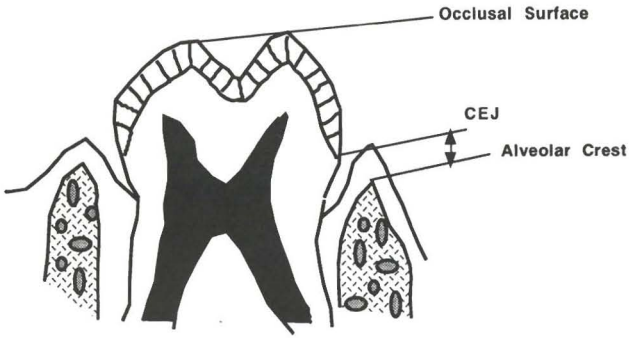

Figure 1. Diagrammatic representation of the measured distance between cementoenamel junction (CEJ) and alveolar crest.

MATERIALS AND METHODS

Bitewing radiographs exposed on all healthy seven to nine-year-old children, seen for routine care in the months of June to September of 1993 at the Children's Hospital dental clinic in Boston, MA (CH) and a private pediatric dental office (PP) were examined. No more than one pair of bitewings was used for each subject. All patients included in the study were ASA (American Society of Anesthesiologists) I classification. Bitewing radiographs were taken without the aid of any standardizing or angulating devices. To determine the accuracy of measurements made on routine bitewing radiographs taken without a standardizing device, three sets of bitewing radiographs were exposed on a human skull with an intact primary dentition, with and without a standardized angulating device (Rinn, Elgin, IL). Measurements of the bone level were made and compared.

Posterior bitewing radiographs were considered acceptable for evaluation, if they met the following criteria;

- ☐ Minimal evidence of distortion;
- ☐ Minimal overlapping of interproximal contacts;
- ☐ A clear image of the alveolar crest (AC) and the cementoenamel junction (CEJ).[25]

The patient's age and sex were recorded. All bitewing radiographs were viewed with the aid of a Kodak High Intensity Illuminator (Model #DE 200, 110 volts, 60 cycle, 0.70 amps; Star X-Ray Co., Inc., Amityville, NY) by one of the authors (TCK) under standardized lighting conditions. The distance from cementoenamel junction to alveolar crest that was perpendicular to the occlusal surface (Figure 1) of the mesial aspect of the first primary molar, mesial and distal aspects of second primary molars, and the mesial aspect of permanent first molars was measured using a four-inch digimatic caliper (Model #500–320, Mitutoya Corporation, Commercial Scale Co., Agawam, MA) which has accuracy to 0.01mm. Only teeth that were fully erupted and shown to be in occlusion on the bitewing radiograph were utilized. Values were measured as negative, if the cementoenamel junction was below the alveolar crest. Teeth with pulpal involvement and/or furcal, periapical radiolucency, or not in full occlusion were not included. Teeth restored with stainless steel crowns were included only if the cementoenamel junction was visible.

Intraexaminer reliability was tested by rescoring ten randomly selected sets of radiographs and an analysis of variance (ANOVA) was used to compare the two readings. ANOVA controlling for multiple observations (i.e., teeth for the right and left sides) and position compared measured distances made with and without the standardized angulation device.

ANOVA models also examined the relationships among several variables and the rank of the measured distance.[29] Variables examined in this fashion were age, sex, dental arch, position within each arch, and right or left side of the mouth. After the best model was fit, we examined whether the child was seen in the private pediatric dental office or the hospital clinic and whether the presence or absence of interproximal caries or restorations and contacts were significant factors. F-tests indicated the significance of the contribution of each variable.

Analyses were performed on a Dell personal computer (Dell Computer Corporation, Austin, TX) using the statistical programs STATA (Stata Corporation, College Station, TX) and SAS (SAS Institute, Cary, NC).

RESULTS

Accuracy of technique

Analysis of variance on ranked data revealed that there was no difference in the measured distance from the cementoenamel junction to the alveolar crest whether bitewing radiographs were exposed on the human skull with or without a standardized angulating device ($p=0.43$). Analysis of variance on ranked data and Duncan's multiple range test revealed that there was no significant difference between the measurements of the ten sets of bitewings measured on two separate occasions ($p=0.76$).

A total of 223 pairs of bitewing radiographs from 223 subjects were included in the analyses. A total of 2734

Table 1 □ Median (minimum, maximum) distance (mm) from the cementoenamel junction to the alveolar crest by tooth and site for 7, 8 and 9 year-old boys and girls.

Boys	Molar	Site	7 years (N=36)	8 years (N=36)	9 years (N=29)
Maxilla	1st primary	distal	1.26 (0.00,2.52)	1.36 (0.00,2.55)	1.35 (0.00,3.00)
	2nd primary	mesial	1.11 (0.00,2.03)	1.16 (0.00,2.54)	1.17 (0.00,4.30)
		distal	1.02 (0.00,2.32)	1.29 (0.00,3.79)	1.15 (0.00,3.10)
	1st permanent	mesial	0.00 (−1.01,1.28)	0.48 (−1.20,1.46)	0.53 (−0.83,1.24)
Mandible	1st primary	distal	1.01 (0.00,1.75)	1.15 (0.00,2.05)	1.06 (0.00,1.67)
	2nd primary	mesial	1.00 (0.00,2.60)	0.93 (0.00,1.80)	1.02 (0.00,2.18)
		distal	0.77 (0.00,1.62)	0.87 (0.00,1.90)	0.94 (0.00,1.59)
	1st permanent	mesial	0.36 (−0.74,1.37)	0.53 (−0.77,1.22)	0.45 (−1.05,1.48)
Girls			(N=38)	(N=50)	(N=34)
Maxilla	1st primary	distal	1.39 (0.00,2.71)	1.33 (0.00,3.28)	0.90 (0.00,2.02)
	2nd primary	mesial	1.25 (0.00,1.98)	1.21 (0.00,2.70)	1.10 (0.00,2.55)
		distal	1.10 (0.00,4.44)	1.22 (0.00,3.34)	0.99 (0.00,2.30)
	1st permanent	mesial	0.28 (−1.35,2.15)	0.43 (−1.32,1.26)	0.64 (−0.65,1.73)
Mandible	1st primary	distal	1.04 (0.00,2.04)	1.14 (0.00,1.85)	0.58 (0.00,1.62)
	2nd primary	mesial	0.94 (0.00,1.80)	0.96 (0.00,1.72)	0.81 (0.00,2.32)
		distal	0.87 (0.00,2.15)	0.73 (0.00,1.54)	0.63 (0.00,1.69)
	1st permanent	mesial	0.52 (−0.91,1.25)	0.53 (−1.20,1.21)	0.48 (−1.08,1.21)

sites were examined with 192 having interproximal restorations, 343 with interproximal caries and 101 with open contacts. There was no statistically significant difference in the sex ($p=0.32$) or age ($p=0.55$) distribution of the PP and CH populations. ANOVA on ranked cementoenamel junction to alveolar crest distances controlling for tooth, age and sex showed that these measurements for PP and CH were not significantly different, so the remaining analyses combined measurements from both populations. Similarly, almost without exception, no significant differences were found between the corresponding teeth on right and left sides of the mouth. Thus, in each subject, the sixteen tooth sites examined were combined into eight sites for all subsequent analyses.

Measurements in different age-groups

Since the distributions of the cementoenamel junction to alveolar crest distance for each tooth-site were not normal, the median and the lower and upper quartile (25 percent and 75 percent) values were reported for each tooth-site rather than the mean and standard deviation. Table 1 presents the measurements for the interproximal areas without caries, restorations or open contacts (2091/2734) of both males and females respectively for each of the three age-groups studied. Median distances for the primary molar sites ranged from 0.58mm to 1.39mm and 0.00mm to 0.64mm for the mesial aspect of the permanent molars. The range of measured distance for the permanent molars was narrower than the primary molar sites. Measurements in both the maxillary and the mandibular permanent teeth included some values of less than zero, which was not observed in the primary interproximal measurements. Figure 2 illustrates the median distances for each tooth-site for each of the age-groups combining males and females.

Predictors of measured distance

In the final ANOVA model, the child's sex and age, dental arch, and position within each arch were significant predictors of the measured distance from the cementoenamel junction to the alveolar crest. On the whole, males had greater, but not statistically significant, distances than females ($p=0.11$) and eight-year-olds had greater distances than seven and nine-year-olds ($p<0.001$). For each primary molar tooth-site at all ages, the median distance from the alveolar crest to the cementoenamel junction for the maxillary molars was greater than their mandibular counterparts ($p<0.001$) (Figure 2). This finding was not consistently true for the mesial aspect of the first permanent molars (Figure 2). At age seven the mandibular permanent molars had a significantly greater distance than their maxillary counterparts (0.51mm; $p<0.001$). At age eight, the mandibular permanent molars still had a slightly greater distance than their maxillary counterparts, but the difference was not significant (0.06mm; $p=0.32$). By age nine, however, the maxillary permanent molars had greater distances than their mandibular counterparts (0.10mm; $p=0.07$). As the interproximal site is positioned more anteriorly in the oral cavity, the median distance from the alveolar crest to the cementoenamel

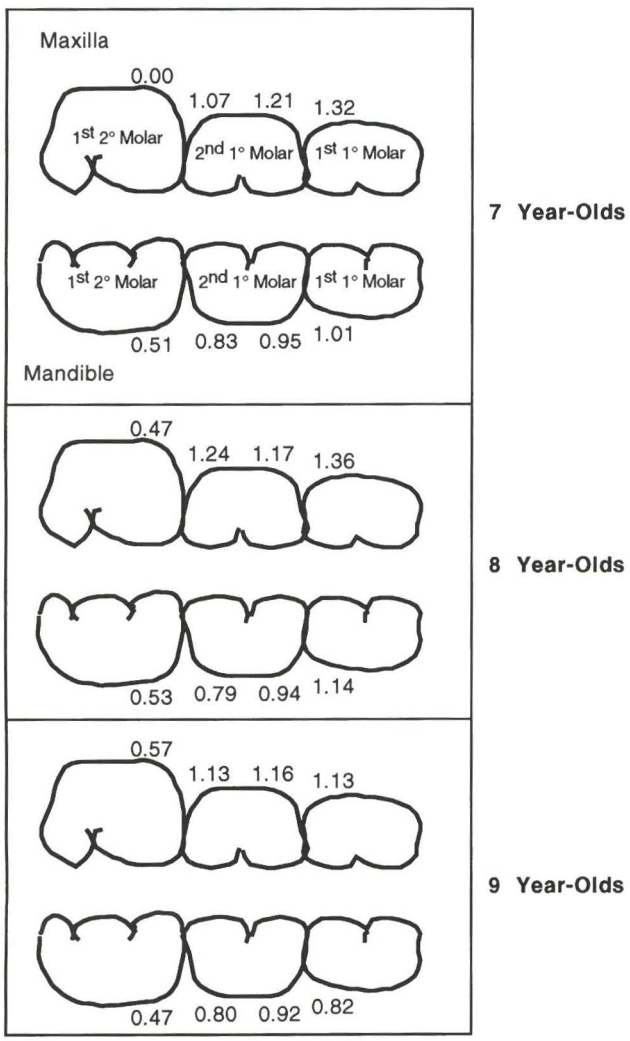

Figure 2. Median distance (mm) from cementoenamel junction to alveolar crest for each age-group combining boys and girls.

junction was also greater (P<0.001) (Figure 2). That is, the distance from the alveolar crest to the cementoenamel junction decreases progressively from the anterior region to the most posterior molar region.

There was a significant age-sex interaction of the measured distances (p<0.001). Among males the distance was smallest at age seven, greatest at age eight and in between at age nine. Conversely, the greatest distance among females was measured at age seven and eight (no difference in measurements at these two ages) and smallest at age nine (Figure 3).

The additional variables (interproximal caries or restorations and contact) were examined one at a time in

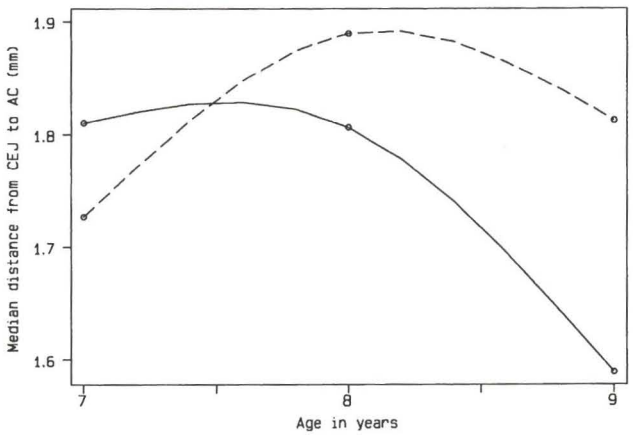

Figure 3. Changes in median distance for boys (broken line) and girls (solid line) as a function of age.

the final ANOVA model. Of all sites measured, 7.0 percent (192/2734) had interproximal restorations, 12.5 percent (343/2734) interproximal caries and 4.0 percent (108/2734) open contacts. After adjusting for tooth position, age and sex, the distance was significantly greater for teeth with interproximal restorations when compared to those without (p=0.01). Similarly, distances tended to be greater for teeth with interproximal caries (p=0.08) and significantly greater for those teeth without interproximal contact (p<0.001).

DISCUSSION

To date, only a few previous studies attempted to investigate the normal alveolar crestal bone height of healthy children in the mixed dentition.[24–28] These studies all used non-U.S. populations. Bimstein and Soskolne (1988) were the first to report on the levels of the alveolar bone crest in the primary dentition. They examined bitewing radiographs from sixty-three three-to-eleven-year-old Israeli children. The mean distance for all the measurements was l.0mm with the measurements increasing with age and the more anteriorly placed sites.

In 1992 Sjödin and Matsson reported normal ranges for the radiographic distances between the cementoenamel junction and the alveolar crest in the primary dentition.[26] Their sample consisted of 128 seven to nine-year-old Swedish children. The majority of sites were 2.0mm or less and were almost symmetrically distributed around a mean of l.0mm (range 0.0 to 4.0mm). The mean distance increased, however, to 2.0mm, when

Table 2 ☐ Radiographic studies of the distance between the CEJ and alveolar crest of primary molars of children.

Investigator (Year)	Findings	Subjects (N)	Age range (years)	# of sites	Population Type of study
Bimstein & Sosklone (1988)[25]	• 1.0 mm mean distance • increases with age • greater for anterior sites	63	3–11	350	Israel cross-sectional
Sjödin & Matsson (1992)[26]	• 1.0 mm mean • 2.0 mm if exfoliating and erupting teeth included • >2.0 mm considered pathology	128	7–9	1851	Sweden cross-sectional
Bimstein (1995)[27]	• <2.0 mm - majority of measurements • 2-3 mm for ages > 9 years-old • increases with age	316	4–12	2007	Israel cross-sectional
Shapira et al. (1995)[28]	• 0.9 mm mean distance • increases with age • greater for anterior sites • greater in maxilla than mandible • greater for boys than girls (not statistically significant)	33	4–12	1500	Israel longitudinal
Needleman et al. (1996) (present study)	• 0.6 - 1.4 mm median distances • varies with age (8 years-old > 7 and 9 year-old) • greater for anterior sites • greater in maxilla than mandible • greater for boys than girls (statistically significant) • greater if interproximal restoration, caries or open contact	223	7–9	2734	United States cross-sectional

neighboring erupting permanent and exfoliating primary teeth were included. Thus, they suggested that any bone level τ2mm should be considered pathological bone loss.

In 1995 Bimstein measured the alveolar bone height of primary canines and molars on bitewing radiographs of 316 four-to-twelve-year-old Israeli children.[27] They reported that the vast majority of measurements were less than 2.0mm and levels increased with age. They suggested that alveolar bone levels between 2 to 3mm were normal in children τ nine-years-old.

In 1995 Shapira *et al* measured the longitudinal changes in the alveolar bone levels of primary canines and molars on 174 bitewing radiographs of thirty-three four to twelve-year-old Israeli children.[28] They assessed the effects of age, sex, tooth, side of the mouth, jaw, site and facial growth on these measurements. They reported that the distances increased with age, although not in a simple linear fashion, with growth spurts occurring at four-to-six and nine-to-twelve-years old. The mean distance was different for the different teeth within each age-group, and different ages at a given site. The greatest distance was at the distal of the canine, while the shortest was at the second molar. Distances were greater in the maxilla than the mandible, and boys had larger values than girls at all the ages, although this was not statistically significant.

The purpose of this study was to shed further light on measurements of normal alveolar bone height of the interproximal sites of the primary and first permanent molars, using a sample of healthy U.S. seven to nine-year-old children. In addition, this study also attempted to determine whether the alveolar bone height varied as a function of age, gender, dental arch, position within the arch, interproximal caries, or restorations and contact.

The medians, lower and upper quartiles and ranges of the measured distance were reported for the eight sites for both sexes (Table 1) in an attempt to help clinicians delineate normal values for the distance from cementoenamel junction to alveolar crest at these locations. The median values reported for the primary molars of seven to nine-year-old children in this study (0.58 to 1.39mm) fall within the range of values previously reported (Table 2).[24–28] Similarly, the values reported for permanent molars by this study (0.00–0.63 mm) correspond to those reported by Yu, who reported distances of 0.0 to 1.0 mm for fifteen-year-old children.[30]

Since our measurements of the distance from the alveolar crest to the cementoenamel junction were not normally distributed, values were expressed as medians with upper and lower quartiles. An important question to ask is at what level should alveolar bone height be considered clinically abnormal? Using varied criteria and populations of children and adolescents, studies have documented periodontal disease in these groups ranging from 0 percent to 51.5 percent (Table 3).[1–16] Much of this variability in prevalence data is likely due to different criteria used to define periodontitis, although most authors agree that any measurement of the primary molar alveolar height τ 2mm should be considered abnormal.[5,7,12,14–16,25–28] Should any value that falls within the

Table 3 ☐ Studies of the prevalence of periodontal disease in children and adolescents

Investigator	Criteria	Subjects (N)	Age range (years)	Prevalence (%)	Population
Jamison (1963)[1]	Ramfjord PDI >3	67	5-7	26.9	USA
		68	8-10	25.0	USA
		24	11-14	20.8	USA
Russell (1971)[2]	Russell's Periodontal Index		5-9	0.1	Caucasians-USA
	"Periodontal Pocket Formation"		8-10	0.0	Blacks-USA
			11-14	1.0	Caucasians-USA
Lennon & Davies (1974)[3]	AL ≥ 1mm	590	15	46.3	England
	AL ≥ 2mm		15	11.0	
Hull et al. (1975)[4]	Irregularity of AC w/loss of continuity; CEJ-AC >3mm	602	14	51.5	England
Gjermo et al. (1984)[5]	CEJ-AC >2mm	214	13-16	27.6	Brazil
Buckley (1986)[7]	CEJ-AC >2mm	1492	7-12	1.7	Ireland
Shlossman et al. (1986)[8]	AL ≥ 2mm	650	5-9	7.7	Native American
			10-14	0.4	
Main & Ellen (1986)[9]	AL	261	8	9.1	Canada
Sweeney et al. (1987)[10]	Radiographic bone loss	2264	5-11	0.9	Cauc, Black, Asian - USA
Bimsteim et al. (1988)[12]	CEJ-AC >2mm	1026	2-18	8.9	USA
Cogen (1992)[13]	Arc-shaped radiographic bone loss	1585	≤15	0.3	Caucasians - USA
		3172		1.5	Black - USA
Neely (1992)[14]	CEJ-AC ≥2mm on > 1 primary molar; confirmed AL ≥3mm	1038	10-12	<0.1	USA
Bimstein et al. (1994)[15]	CEJ-AC >2mm w/loss of lamina dura	317	5	2.1	New Zealand
Sjödin & Matsson (1994)[16]	CEJ-AC >2mm	8666	7-9	2.0-4.5	Swedish

AC = alveolar crest
AL = attachment loss
CEJ = cementoenamel junction
PDI = Periodontal Disease Index

upper quartile of our data be considered pathological? Most importantly, how easily can the loss of crestal bone be detected by clinicians evaluating bitewing radiographs at chairside. The differences between the median and the upper quartile measurements in our population were extremely small, ranging from a minimum of 0.20 mm to a maximum of 0.38 mm for the eight sites evaluated. Clearly, the differences between the median and the maximum values for each of the eight sites were larger ranging from a minimum of 0.97 to a maximum of 3.27 mm. The magnitude of these differences should be radiographically discernable to clinicians. Should practitioners routinely measure the distances between the alveolar crest and cementoenamel junction, using our methodology to detect early signs of periodontal disease? The results of this and previous other studies should form a basis for the beginning of such a discussion among dentists who routinely treat children. In addition, these types of surveys should be increased in size and scope to include other populations and age-groups to obtain reliable norms.

For each primary tooth-site the distance from the alveolar crest to the cementoenamel junction for the maxillary molars was greater than for their mandibular counterparts. Previous studies have consistently reported that the molar bone levels are greater in the maxilla than in the mandible.[7,12,17,28,30–32] One possible explanation is that plaque and calculus accumulations are greater in the maxilla than the mandible.[33,34] Another possible explanation is that the cortical bone in the maxilla is thinner, less dense and less rigid than in the mandible.[35] Thus, the maxillary alveolar bone undergoes resorption more readily than in the mandible.

Although the measured distances for the permanent maxillary molars were very similar to those observed in the mandible, when all age-groups were combined, differences were noted, when each of the age-groups was analyzed separately. At age seven the mandibular permanent molars had significantly greater distances from cementoenamel junction to alveolar crest than their maxillary counterparts. Similarly, at age eight the mandibular permanent molars had slightly greater distances from cementoenamel junction to alveolar crest than their maxillary counterparts, but the differences were not significant. By age nine, however, the maxillary permanent molars had a significantly greater distance than their mandibular counterparts. This pattern may be due to the earlier eruption of the mandibular permanent molars, with relatively longer periods for passive eruption and exposure to dental plaque.[36,37] By age eight the maxillary permanent molars have been erupted for a comparatively similar period so that the differences in the measured distances when compared with their mandibular counterparts are less. By age nine the maxillary permanent molars have greater distance from cementoenamel junction to alveolar crest than their mandibular counterparts, perhaps due to the anatomic differences in the cortical plates and bone densities.

Our data coincided with the findings of Bimstein and Sosklone (1988) and Shapira *et al* (1995) that as the in-

terproximal tooth sites are positioned more anteriorly in the oral cavity, the distances between the cementoenamel junction and the alveolar crest increase.[25,28] This may be due to pure anatomic differences in tooth sites. Alternatively, since the primary molars erupt chronologically from the anterior to the posterior of the oral cavity the more anteriorly positioned teeth and their corresponding interproximal sites have more time for active and/or passive eruption to occur, thus increasing the distance from the cementoenamel junction to the alveolar crest.[38] Alternatively, the more anteriorly positioned teeth are exposed to damaging effects of dental plaque for a longer period of time; their alveolar bone height, therefore, is lower.

In our study population, males generally had greater distances than females, which agrees with the findings reported by Sjödin and Matsson (1994).[26] They showed that boys suffered bone loss and calculus formation significantly more often than girls. Similarly, Shapira *et al* (1994) reported that boys had greater distances than girls, although this trend was not statistically significant.[28] It has been reported that males have a higher prevalence and severity of periodontal disease than females, although this difference is very slight before age twenty.[33,39] In the study by Gjermo *et al* fifteen-year-old males were reported to have greater bone loss than females.[5] Conversely, Jamesian and Yu both reported that the prevalence of periodontal disease is comparable for both sexes.[1,30] The reason for our reported gender differences needs further investigation.

Age was also a significant variable in determining the distance from the cementoenamel junction-alveolar crest. Numerous studies have reported that these measurements increase with age; our findings indicated, however, that eight-year-olds have greater distances than seven-year-old and nine-year-old individuals.[12,25,27,28,40] This is difficult to explain; the initial increase from seven to eight-year-olds may be due, however, to:

- ☐ Active and passive eruption;[40]
- ☐ A longer exposure to periodontally destructive factors;
- ☐ A change in the nature of the microbial flora over this time period;
- ☐ A statistical phenomenon as a result of combining males and females.

After age eight the initial movement of the unerupted succedaneous teeth and subsequent resorption of the roots of the primary molars may account for the decrease in the alveolar crest to cementoenamel junction distance. Not previously reported was the finding that these differences in measurements for the three age-groups were affected by gender. This supports the statistical rationale (i.e., combining males and females) explaining the increase followed by the decrease of measurements from seven to nine-years of age. Specifically, the distances were greater for males at age nine than at age seven, yet the reverse was true for females (Figure 3). The reason for this difference may be due to the earlier eruption of the permanent canines and premolars and earlier exfoliation of their primary predecessors for girls when compared with boys.[41,42] An early eruption pattern for girls with initial movement of the succedaneous tooth to resorb the roots of the primary teeth may result in a decrease in the interproximal alveolar bone height with age.

The most dramatic and consistent change in the alveolar crest to cementoenamel junction distance occurred at the mesial aspect of the first permanent molar. This distance steadily increased with age for each sex from age seven to age nine often starting with a negative value probably due to some or all of the reasons previously discussed.

It is important to note that although many of our findings were statistically significant, the differences were very small in clinical terms, all less than 1mm and some as small as 0.1mm. The differences comparing the sites as a function of location, sex, or age, may not be, therefore, clinically meaningful.

Several studies in the past have demonstrated both positive and negative relationships between periodontal disease and interproximal restorations, interproximal caries, and proximal contact.[12,30,33,43] Our data supported these previous findings and current clinical knowledge that interproximal restorations and caries, and lack of interproximal contact are associated with an increase in the distance from cementoenamel junction to alveolar crest due to plaque, calculus, and food accumulations where nonphysiologic interproximal relationships may exist. Only a few of our interproximal sites examined, however, had caries or restorations, and most teeth examined were in direct contact with the adjacent teeth. The differences noted were calculated, therefore, from a very small number of affected sites. In order to improve documentation of the associations between interproximal restorations and caries and alveolar bone height, a longitudinal study examining the alveolar bone height before and after caries development, placement of estorations and contact development is needed.

CONCLUSIONS

- ☐ The median values for the distance from the alveolar crest to the cementoenamel junction for the interproximal sites of the primary molars of seven-to-nine-year-old children ranged from 0.58 to 1.39mm and 0.00 to 0.63mm for the mesial interproximal sites of the first permanent molars.
- ☐ There was no significant difference in the alveolar bone height for the eight sites between the left and right sides of the mouth.
- ☐ Males had greater distances than females.
- ☐ Eight year-olds had greater distances than seven and nine-year-olds.
- ☐ There was a significant age-sex interaction with the smallest measured distance for boys at age seven, but at age nine for females.
- ☐ For each primary tooth site, the distance from the alveolar crest to the cementoenamel junction for the maxillary molars was greater than its mandibular counterpart.
- ☐ For the mesial of the permanent first molar, measured distances for the maxilla were very similar to those observed in the mandible when all age groups were combined. At age seven, however, the mandibular measurement was greater and by age nine the maxillary measurement was greater.
- ☐ As the interproximal tooth sites are positioned more posteriorly in the mouth, the distances between the cementoenamel junction and the alveolar crest decrease.
- ☐ Interproximal restorations and lack of interproximal contact were significantly associated with an increase in the distance from cementoenamel junction to alveolar crest, while there was a tendency for this to be true for interproximal caries.

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ALCOHOL, TOBACCO, AND OTHER DRUG USE

This study indicates that use of licit substances in rural areas is similar to or exceeds that for urban areas. Rural use of some illicit substances in the early 1990s was similar to that in urban areas, and this differs from trends characteristic in the 1970s and 1980s. These findings contrast with the popularly held notion that rural youth are more protected against the use and abuse of drugs by their distance from the factors supporting drug use in urban environments (crime, social disorganization, poverty, drug availability). Of particular note is the convergence of urban and rural rates of use in the face of declining overall use rates for most substances. This suggests that substance availability has changed in rural areas, that prevention efforts are less common or less effective, or that social factors protecting rural youth from drug use and abuse have changed from 1976 to 1992. Alternatively, youth from urban areas may have reduced use levels because of a greater awareness of problems associated with substance use.

Most notable and of concern among the findings reported here are those dealing with legal substances that enhance the risk of morbidity and death for the individual. Rural students show more stable and substantially higher prevalence for excessive use of cigarettes, a substance associated with increased mortality. Daily use of alcohol and binge drinking, often associated with automobile accidents and death, and increased risk for violent behavior, show the greatest excess among rural students, particularly males, as compared with urban students.

Policymakers must acknowledge that the use of alcohol and other drugs is a problem for both urban and rural youth. Policy especially related to alcohol and tobacco use must be developed for rural populations. From morbidity, mortality, and economic perspectives, these drugs cost our society much more than other drugs, and they appear to be a greater problem in rural than in urban areas. Prevention programs based on multiple components implemented through comprehensive community health strategies must be emphasized. Policymakers must encourage the use of education programs that have been shown through carefully designed and controlled evaluation studies to be effective. Unfortunately, as pointed out by Ennett and colleagues, popular programs that show limited effect, such as DARE (Drug Abuse Resistance Education), are often implemented in place of other, more beneficial programs.

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A comparative study of midazolam to meperidine/promethazine as an IM sedative technique for the pediatric dental patient

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The young pediatric dental patient with severe oral disease and severe acute situational anxiety presents a management challenge to pediatric dentists. Dental treatment using general anesthesia is expensive. Conscious sedation should be considered, therefore, as an alternate treatment modality.[1]

Houpt reported in a 1991 update that 31 percent of pediatric dentists had decreased their use of office sedation. Pediatric dentistry training programs that were heavy users of sedation had decreased their use as well.[2] Duncan *et al* conducted a survey on premedication practices of diplomates of the American Board of Pediatric Dentistry.[3] Seventy-five percent of diplomates utilized sedatives to facilitate treatment in patients with acute situational anxiety.[4] Orally, chloral hydrate has commonly been used in combination with hydroxyzine or promethazine. Intramuscularly, meperidine has been used alone or in combination with promethazine, and is perhaps the most widely studied IM premedicament for children.[1,5-7]

Myers *et al* reported excellent to adequate success with meperidine hydrochloride, promethazine hydrochloride and chlorpromazine.[8] Their success was better in patients less than thirty-six months of age. Smith *et al* used chlorpromazine, promethazine and meperidine hydrochloride on children undergoing cardiac catheterization as an alternative to general anesthesia, and reported success.[9]

While there is little in the dental literature on the use of IM sedative agents, they appear to be safe and can be of great benefit in patient management. The benzodiazepines, as a class, are safe and effective anxiolytics and sedatives. Midazolam is among the newest benzodiazepines and is available for parenteral use owing to its lack of tissue irritation. It has not, however, been widely studied for use in pediatric dentistry.

Salonen *et al* found that midazolam failed to produce sleep in a large majority of children even at the higher dose levels.[10] Their opinion was that the benzodiazepines were best suited to be used as an adjuvant to local or general anesthesia. Taylor *et al* found that IM midazolam served as a satisfactory sedative agent.[11] There was a higher incidence of retrograde amnesia and a more rapid postoperative recovery. Payne *et al* reported a 60 percent incidence of amnesia using IM midazolam.[12]

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The purpose of this double blind, randomized crossover study was to evaluate the efficacy and safety of midazolam as an IM sedative agent in the pediatric dental population, compared to the standard IM meperidine/promethazine sedation technique.

MATERIALS AND METHODS

Ten ASA Class I children, ages two to four years, participated. The patients required at least two quadrants of restorative dental treatment and demonstrated severe acute situational anxiety. Patients fulfilling the criteria had a consent for sedation form signed by the parent or legal guardian. A consent form for participation in the research study was also signed. The study was designed as a double-blind, randomized, crossover study, with two sedation appointments scheduled one week apart. This study met all of the requirements and guidelines outlined by the Institutional Review Board and was conducted under an approved protocol.

Each patient's weight and an updated medical history were recorded at the patient's examination appointment. The drugs to be utilized were obtained from the university pharmacy. Dosages were calculated by the pharmacy staff according to the following schedule: midazolam(0.2mg/kg); meperidine(2.0mg/kg); and promethazine(1.0mg/kg). The drugs utilized for each of the two sedations were to be revealed to the operator only in case of an untoward reaction or emergency. The dosages were delivered to the operator on the days of the appointments and were in equal volumes to prevent the possibility of determining which drugs were utilized for each sedation. The patients were randomly assigned the drug to be administered on the first appointment.

Each patient was NPO five hours before sedation. The patient's vital signs were recorded via a Dinamap@ blood pressure cuff (Critikon, Inc., Tampa, FL), pulse oximeter (Nellcor, Hayward, CA), and a precordial stethoscope preoperatively and thereafter every five minutes. The patient was then placed in a Papoose Board@ (Olympic Medical Corp., Seattle, WA). The patient received the IM injection thirty minutes before the planned initiation of dental treatment. The left musculus vastus lateralis was the site of the injection. Emergency drugs and equipment were available at all times. A faculty advisor appointed in oral and maxillofacial surgery and anesthesiology as well as a board certified pediatric dentist were present throughout each sedation.

All patients received 50 percent nitrous oxide/oxygen throughout the course of treatment. Routine dental restorative procedures were performed after local anesthesia was obtained, using 2 percent xylocaine with 1:100,000 epinephrine. The sedation course was evaluated by the operator every ten minutes. Observation included sleep, movement, crying, and overall behavior (Table 1).[13] At the end of the procedure, the patient was shown a brightly colored object. At the one-week follow-up, the patient was asked to identify the object to assess amnesia associated with the sedation appointment. At the completion of the sedation, the patient was monitored for at least fifteen minutes to observe any possible complications or prolonged sedation. Written and verbal postoperative sedation instructions were presented to the parent or legal guardian at the termination of treatment. Follow-up phone calls were made the night of and day after the sedation.

Table 1 ☐ Sedation evaluation rating scale (Adapted from Houpt *et al.*[13]

Rating scale	Score
Sleep	
awake but responsive	4
drowsy, disoriented	3
asleep, easily aroused	2
asleep, difficult to arouse	1
Movement	
no movement	4
intermittent movement not affecting treatment	3
continuous movement affecting treatment	2
violent movement that interrupted or prevented treatment	1
Crying	
no crying	4
intermittent crying	3
continuous, persistent crying	2
hysterical crying	1
Overall behavior (recorded at end of tx)	
excellent, no disruption	6
very good, limited disruption, treatment completed without difficulty	5
good, some difficulty, but treatment performed	4
fair, much difficulty, but all treatment performed	3
poor, partial treatment	2
aborted	1

RESULTS

Based on the Wilcoxon rank sum test, there was no statistically significant difference noted for the drug regimens based on time of treatment, pulse rate, systolic blood pressure, overall behavior, or memory.

There was, however, a statistically significant difference between sleep experiences ($p=0.005$). Patients sedated with midazolam tended to be drowsy and disoriented, but were more awake than patients sedated with meperidine/promethazine. There were statistically significant differences between the two regimens. There was a statistically significant difference between movements ($p=0.019$). Patients sedated with midazolam tended to move. This movement did affect treatment

Table 2 ☐ Analysis of treatment interval variables.*

Variable mean median std dev	Midazolam	Meperidine/ promethazine	Statistical significance
Time	49.000	54.000	p >.5
	45.000	55.000	
	22.086	18.679	
Pulse rate	134.700	125.400	p >.5
	130.000	119.000	
	25.073	19.185	
Systolic blood pressure	116.200	114.700	p >.5
	115.500	112.500	
	13.332	12.000	
Sleep	3.087	2.521	p=0.005
	3.120	2.415	
	0.299	0.452	
Movement	2.734	3.455	p=0.019
	2.715	3.430	
	0.624	0.453	
Crying	2.634	3.281	p=0.035
	2.545	3.285	
	0.593	0.565	
Overall behavior	3.900	4.600	p=0.123
	4.000	5.000	
	0.879	1.578	
Memory test	0.500	0.444	p >.5
	0.500	0.000	
	0.534	0.527	

*Analysis performed using the Wilcoxon Rank Sum Test

Table 3 ☐ Overall sedation rating.*

Rating scale	Rating score midazolam mean	Rating score meperidine/ promethazine mean	Statistical significance
Sleep	3.09	2.52	p=.0010
Movement	2.73	3.46	p=.0268
Crying	2.63	3.28	p=.0251
Overall behavior	3.90	4.60	p=.31

*Analysis performed using the paired T-test

during the procedure. The patients sedated with meperidine/promethazine often displayed either intermittent movement that did not affect treatment or no movement during the procedure. There were statistically significant differences between the two regimens. Despite these differences, treatment was completed, using both regimens.

There was a statistically significant difference between crying episodes (p=0.035). Patients sedated with midazolam tended to exhibit continuous, persistent crying. Patients sedated with meperidine/promethazine tended to have intermittent crying or no crying at all during the procedure (Table 2).

Overall sedation ratings were statistically analyzed using paired T-test of mean values for sleep, movement, crying, and overall behavior (Table 3). There was statistically no significant difference between the two drug regimens, based on overall behavior evaluated at the end of the procedure. Patients sedated with midazolam tended to be rated as good, while patients sedated with meperidine/promethazine were rated as very good. In all cases, treatment was completed.

During sedations with both drug regimens, there were no complications or untoward reactions. There were no episodes of apnea. Oxygen saturation was 96 percent or greater throughout the sedation procedure. There was no significant increase in blood pressure or pulse rate during the sedation procedures. There were no reported side effects of nausea, vomiting or increase in drowsiness with either drug regimen, following the sedation appointments. Also there was no significant difference in memory, following the sedation appointment with either drug regimen.

DISCUSSION

The results of this double-blind, randomized, crossover study indicated that midazolam sedations were less effective than meperidine/promethazine sedations regarding sleep, movement, and crying. Treatment was completed in two sedation appointments on each of the ten subjects evaluated. There were no significant differences noted for overall behavior. Both drug regimens were effective from the standpoint that all restorative procedures were completed. While a small number of patients participated in this study, the crossover design ensured that patients could be compared to themselves. It is not easy to compare the results of this study with others, as many of the studies in the anesthesia literature use midazolam as a premedication before general anesthesia, while pediatric dental patients are specifically expected to maintain consciousness, yet be cooperative.

Nitrous oxide was not a variable in this study. All patients received 50 percent nitrous oxide/oxygen throughout the procedure, with no incidents where the nitrous oxide/oxygen was removed. Nonetheless, the actual concentration that each patient received is related to variables such as mouth breathing, position of the rubber dam, and fit of the nasal mask, so the final alveolar concentration received cannot be determined.

Sedation procedures produce behavioral effects that can be very challenging to evaluate, and rating of efficacy may vary greatly among the investigators. This study as well as current sedation studies used a rating scale devised by Houpt *et al.*[2,6,7,14] Because patients were placed in a Papoose Board, their movements were already limited and could be considered difficult to evaluate. Despite this, a significant difference in movements was noted.

Moore *et al* noted that serious adverse reactions had been observed with narcotic sedation of children.[15] The

four factors that they pointed out as contributing to these were multiple drug administration, excessive dosage, inadequate monitoring, as well as ineffectual emergency care. Goodson *et al* described life threatening reactions following pediatric sedations.[16] All patients in this study showed minimal or no changes in vital signs or oxygenation regardless of the regimen used, further supporting the safety of the narcotic regimen used in this study.

The reported decrease in use of pediatric sedation by pediatric dentists may result from difficulty in complying with sedation guidelines, state legislation, and increased malpractice insurance costs. The pediatric dentist using sedative techniques in the office should, however, still consider IM sedation as an acceptable technique for use in select patients. This implies that IM techniques require continual investigation in pediatric dental patients as a useful alternative to general anesthesia.

In summary, both midazolam and meperidine/promethazine were effective for IM sedation in pediatric dental patients, in as much as there was no difference in overall patient behavior. Midazolam was less effective, however, than the meperidine/promethazine regimen related to patient sleep, movement, and crying.

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HOW EXERCISE WORKS ITS MAGIC

Although researchers are arguing about how much exercise you need to reduce your risk of heart disease, there is no doubt that at some point, physical benefits do kick in. "Exercise has lots of different effects" that can help protect your heart, says cardiologist Paul Thompson of Hartford Hospital in Hartford, Connecticut. Among them: It lowers blood pressure, boosts blood volume, and consumes "bad" fats in the blood (such as triglycerides), while also raising levels of the so-called good cholesterol carried in the blood's high-density lipoprotein (HDL) particles.

One of the best documented effects of exercise is on blood pressure. Even a single bout of moderate exercise can help. Exercise not only lowers the pressure in arterial vessels, it also increases the volume of blood coursing through the entire vascular system. Thompson injected tracer substances into the bloodstreams of highly fit male distance runners; using the resulting concentration of the tracer to determine blood volume, he found that runners have nearly a liter more blood than average men.

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Mutans streptococcal serotypes in children with gastroesophageal reflux disease

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Gastroesophageal reflux is a disease that is identified with recurrent regurgitation of acid gastric contents. In a Finnish study 21 percent of adult population were found to suffer from the symptoms when mild cases were included.[1] Gastroesophageal reflux is also common in children, although the prevalence among the child population is not known exactly.

Different clinical symptoms can lead to diagnosis of the disorder, namely chronic respiratory symptoms, gastrointestinal symptoms, and dental erosions. Several grades of dental erosions have been reported in children and adults, running from white spots and etched appearance to dentin exposures on smooth surfaces.[2-4]

Known etiological causes for dental erosions are dietary factors and eating disorders, like anorexia nervosa and bulimia.[5,6] Up to 50 percent of anorexia nervosa patients are reported to practice bulimia also.[5,7] In bulimia the self-induced vomiting brings the gastric content to the upper gastrointestinal system while in gastroesophageal reflux the regurgitation is involuntary. Regurgitation has been suggested as the reason for dental erosions in ancient populations.[8] Thinking of the resulting environment in the mouth, it could be supposed to be rather similar both in bulimics and patients suffering from gastroesophageal reflux disease.

Several studies have dealt with etiological factors of dental erosions, including the ones caused by upper gastrointestinal tract disorders.[2,4,9] Changes in caries and periodontal statuses have been sought, as well as in the salivary flow rate, pH and buffering capacity of the saliva.[5,9-12] Only a few studies have considered possible changes in the levels of *mutans streptococci* in the altered oral environment.[10,11] Even less studied is the serotype distribution of *mutans streptococci* in these circumstances.[10]

Bretz *et al* reported that the prevalence and levels of *mutans streptococci* tended to be higher in bulimics than in nonbulimics. Also, the bulimics had significantly higher levels and higher prevalences of *Streptococcus sobrinus*, when compared with nonbulimics. It was suggested that vomiting in bulimia might favor aciduric bacteria and make the colonization of *Streptococcus sobrinus* easier.[10]

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The aims of this work were to study the isolation frequency and the serotype distribution of *mutans streptococci* and determine whether the children suffering from gastroesophageal reflux disease would have a higher prevalence of *streptococcus sobrinus*, when compared with the healthy control group, matched by age and salivary levels of *mutans streptococci*.

PATIENTS AND METHODS

The study group comprised sixteen children suffering from gastroesophageal reflux disease. The diagnoses were made in the University hospital of Tampere with long-term esophageal pH recordings. Most children had the first pH recording at an early age and all shortly before the bacterial sampling. The mean age of the study group was 9.3 years, and the range from 4.6 to 15.1 years. The control group for the *mutans streptococci* positive gastroesophageal reflux children (n=12) consisted of children having their regular dental care in the Department of Pedodontics and Orthodontics, Institute of Dentistry, University of Helsinki. The control children were matched as closely as possible with the study group by age and salivary levels of *mutans streptococci*. The mean age of the control group was 8.6 years and the range from 4.5 to 11.8 years. The mean salivary levels of *mutans streptococci* in the study and control groups were 7.5×10^5CFU/ml (SD 1.5×10^6) and 9.5×10^5 CFU/ml (SD 2.3×10^6), respectively. The difference was not statistically significant as tested with Mann-Whitney U-test (p=0.649).

At the time of the bacterial sampling, all patients in the study group, except one, had clinical symptoms of the gastroesophageal reflux disease. The mean time between the first diagnosis of symptoms and the bacterial sampling was 7.6 years (range from 4 to 11 years).

For the isolation of *mutans streptococci*, samples of saliva, stimulated by chewing paraffin, were obtained from all subjects. Of each sample 0.3 ml was placed into a vial containing VMGA lll transport medium and inoculated within two days in the microbiology laboratory of the Institute of Dentistry, University of Helsinki. Bacteria were dispersed with Vortex mixing (twenty strokes at maximum setting) and 100-µl aliquots of serially diluted samples were inoculated on MSB agar for the selective culture of *mutans streptococci*.[13] The plates were incubated at 37° C in an atmosphere of 5 percent CO_2 for two days. Colonies were examined for the typical morphology under a dissecting microscope and the total number of colonies was counted. For each child three-to-six single colonies representing each *Streptococcus mutans* and/or *Streptococcus sobrinus* (n=103) were picked and purified for serotyping.

Mutans streptococcal isolates were serotyped by the immunodiffusion technique where antigen extracts were prepared by autoclaving the bacterial cells.[14] The serotypes were determined as described earlier.[15,16] The serotype-specific antisera against mutans streptococcal serotypes *c, e, f, g*, and *d* were prepared in rabbits with whole cell antigens as previously reported.[15,16]

RESULTS

The total of twelve of sixteen gastroesophageal reflux children harbored *mutans streptococci*, a prevalence of 75 percent. In the study group seven subjects harbored *Streptococcus mutans* serotype *c* (7/12; 58 percent), four serotype *e* (4/12; 33 percent) and none serotype *f* (0/12; 0 percent). Out of the two serotypes of *Streptococcus sobrinus* serotype *g* was discovered in three children (3/12; 25 percent) while serotype *d* was not detected at all (0/12; 0 percent). One strain in the study group remained untypable. In the control group the distribution of serotypes was: *c*: 10/12, 83 percent; *e*: 2/12, 17 percent; *f* 1/12, 8 percent; *g*: 2/12, 17 percent; and *d*: 0/12, 0 percent. All patients infected with *Streptococcus sobrinus* were also infected with *Streptococcus mutans*. Plural serotypes were found in three cases, in the study group as well as in the control group.

The serotype distribution closely resembled each other in both groups. Also, the prevalence of *Streptococcus sobrinus* was quite similar when three children in the gastroesophageal reflux group and two in the control group harbored this strain (Fischer Exact Probability 0.500, ns.).

When the study and control groups were combined, the salivary levels of *mutans streptococci* tended to be higher in the children who harbored both *Streptococcus mutans* and *Streptococcus sobrinus* when compared with the children positive for *Streptococcus mutans* only (Mann-Whitney U-test, p=0.057).

DISCUSSION

The present study investigates the isolation frequency and serotype distribution of *mutans streptococci* and the prevalence of *Streptococcus sobrinus* in children with diagnosed gastroesophageal reflux disease. The earlier findings of higher prevalence and levels of *Streptococcus sobrinus* in patients suffering from eating disorders led us to think the same possibility existed in gastroesophageal reflux disease.[10] According to our hypothesis the

more acidic environment would favor the colonization of *Streptococcus sobrinus*, thus altering the serotype distribution of *mutans streptococci*.

For ethical reasons it was not possible to make long-term esophageal pH-recordings from the control children. As gastroesophageal reflux is a rather common disease we cannot rule out that somebody in this group also had the asymptomatic form of gastroesophageal reflux.

The control group of this study was formed by matching children by age and salivary levels of *mutans streptococci*. The age was considered an important factor, because the colonization of new strains may coincide with the age.[17,18] When studying the possible influence of gastroesophageal reflux on the prevalence of *Streptococcus sobrinus* it was important to match the groups by salivary levels of *mutans streptococci*, because higher *mutans streptococci* levels increase the possibility of finding plural serotypes also in healthy children.[19]

In the gastroesophageal reflux group with the mean age of 9.3 years, the isolation frequency of *mutans streptococci* was 75 percent. In the healthy Finnish child population, the prevalence of *mutans streptococci* was 46 percent in five-year-olds and 83 percent in teenagers.[20,21] In a group of Finnish children with a high caries experience and mean age of 8.3 years, 62 percent harbored *mutans streptococci* and two children out of ten were colonized with *Streptococcus sobrinus*.[22] According to these studies it seems that in the present study group *mutans streptococci* were isolated slightly more frequently compared with the average child population of the same age. On this ground it would be tempting to claim that gastroesophageal reflux disease would favor the colonization of *mutans streptococci*. On the other hand the unfavorable dietary habits are known to help the colonization of *mutans streptococci*.[18] We are not able to draw further conclusions of the reason for the high isolation frequency of *mutans streptococci*, when the group was formed entirely on the medical basis without taking a thorough dietary history.

As regards the prevalence of *Streptococcus sobrinus* in our study and control groups, there is no reason to believe that gastroesophageal reflux would be a predisposing factor for the colonization of this bacterium. Bretz *et al* found a higher prevalence and levels of *Streptococcus sobrinus* in young adults with eating disorders, but were not able to conclude whether they resulted from the abnormal eating habits or the emetic activity.[10] It can be asked whether the oral environments in these two groups are comparable after all. Oral pH certainly decreases immediately in vomiting, but this might not always be the case in gastroesophageal reflux. Gudmundsson *et al* completed simultaneous intraoral and intraesophageal 24-hour pH recordings. Although they did not find simultaneous pH changes in the mouth during the reflux episodes, they reported cases of slowly falling intraoral pH to a value between 4 and 5, which causes dental erosion.[12] Also Taylor *et al* reported low oral pH readings in an eight-year-old female suffering from severe dental erosion.[3] It seems likely that oral pH changes must happen at least in the gastroesophageal reflux patients with dental erosions. Even the 24-hour recording is short, however, when speaking of the disease that may last for years with varying symptoms. The negative result, considering the change in the oral pH in one monitoring, does not rule out the possibility that in the long run the oral environment is more acidic. For instance dental erosions could be an example of the long-term effects: there must be a latent period between the first symptoms and developing of the erosive changes. Simmons *et al* reported the significantly lower prevalence of dental erosions in bulimia patients who had been vomiting for less than four years than in those with a longer history of vomiting.[23] Also, Meurman *et al* reported the increasing amount of dental erosions with a longer duration of gastroesophageal reflux.[9] Similarly, the change in the oral flora in an altered environment is more probable with increasing time. In our study group the mean time from the first symptoms of gastroesophageal reflux to the sampling was rather long, 7.6 years. The time had been long enough to cause dental erosions in nine patients out of twelve (data not shown) but it had had no clear influence on oral *mutans streptococci*.

The results with these groups did not reveal any remarkable differences in the serotype distribution of *mutans streptococci*. Despite a likely acidic oral environment in gastroesophageal reflux children, when compared with healthy children, selection toward a higher occurrence of salivary *Streptococcus sobrinus* found in bulimia could not be confirmed.

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DECREASING SMOKING PREVALENCE

The general decline in smoking prevalence, more pronounced among men than among women, has been attributed primarily to various public health actions. There is substantial evidence that public health campaigns, anti-tobacco legislation, and the cost of cigarettes are effective tools in reducing the prevalence of smoking. If the experience from such successful efforts is used effectively, the rate of smoking prevalence may continue to decline among pregnant women.

Intervention studies during pregnancy have generally achieved modest rates of smoking cessation although quit rates around 30 percent in the intervention group have been reported. The most effective intervention studies require substantial effort and funds and can hardly be integrated into routine antenatal care. Our study presents substantial evidence that the prevalence of smoking among pregnant women and the smoking-related attributable risk of small-for-gestational-age births have decreased dramatically during the last decade. It is very likely that these improvements in maternal and child health can be attributed to primary smoking-prevention work in society.

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Oral self-injurious behavior in the developmentally disabled: Review and a case

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Self-injurious behavior or self mutilation has been defined as the deliberate destruction or alteration of body tissue without conscious suicidal intent and occurs in conjunction with a variety of psychiatric disorders as well as various developmental disabilities and some syndromes.[1] The behavior is destructive and causes concern and distress to all involved in the care and treatment of the affected individual.

A dentist is often consulted if the self-injurious behavior involves oral or perioral structures, either because oral tissues are being mutilated or teeth are being used to damage other parts of the body. Biting is the most common self-injurious behavior among developmentally disabled individuals.[2,3]

The prevalence of self-injurious behavior in the general population is not well established, but is estimated to be around 750 in 100,000.[4] Self-injurious behavior is not uncommon among developmentally disabled persons and the prevalence escalates with increasing impairment.[5] Studies have reported a wide range of occurrence of self-injurious behavior among institutionalized developmentally disabled individuals, with most studies showing prevalences in the range of 7.7 percent to 22.8 percent. Griffin *et al* reported a prevalence of 13.6 percent among 10,000 institutionalized individuals in a statewide Texas survey.[2] Less is known about the prevalence in the noninstitutionalized developmentally disabled, but a prevalence of 1.7 percent was reported in a large German study.[3]

ETIOLOGY

The behavioral and biochemical aspects of self-injurious behavior is poorly understood.[6] Many etiologies have been suggested, both organic and functional.

Several syndromes and congenital conditions have been associated with self-injurious behavior, including Lesch-Nyhan syndrome, Cornelia de Lange syndrome, Rett syndrome, XXXXXY syndrome, XYY syndrome, Tourette syndrome and autism.[7-12] Sensory neuropathies may also lead to self-injurious behavior.[13] This includes sensory loss in the afflicted region as well as a more general loss of pain sensation in anesthesia dolorosa.[11] Many other diseases have also been associated with self-injurious behavior.[14-16] Loschen *et al* suggest that anything that causes discomfort, such as sinusitis, headaches and painful dental conditions, can precipitate self-injurious behavior.[17] Nonverbal individuals who cannot communicate distress to a caregiver are at greater risk to develop self-injurious behavior.

A theory involving the diazepam-receptor has been suggested as an etiology of self-injurious behavior. This theory is based on the observation that caffeine, a methylpurine derivative, inhibits the binding of diazepam to its receptors and can elicit self-injurious behavior in rats.

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Substances related to caffeine, the oxypurines, are observed to accumulate in the brains of children with Lesch-Nyhan syndrome.[18] Another proposed organic etiology involves the functions of the endogenous opiate system. This theory postulates that self-injurious behavior is a result of an auto-addictive mechanism where the physical pain results in raised levels of endogenous opiates, or that the opiate system in individuals engaging in self-injurious behavior is abnormal, resulting in elevated pain thresholds. Dysfunction of the dopaminergic system has been implicated in self-injurious behavior that occurs in Tourette syndrome and Lesch-Nyhan syndrome. The behavior is hypothesized to be the result of dopaminergic stimulation in a state of receptor hypersensitivity. Depletion of serotonin in the serotonergic system has also been implicated in aggressive behavior of which self-injurious behavior may be a subset.[6] Several investigators have suggested a behavioral etiology to self-injurious behavior or a behavioral reason for the maintenance or continuation of the behavior.[19-21] This behavioral component could be in the form of negative reinforcement, for example, when the individual escapes demands by engaging in self-injurious behavior. In the developmentally disabled, however, a behavioral component would most frequently be in the form of positive reinforcement of the behavior. Positive reinforcement is obtained when attention is gained and when a caring and mothering response to the behavior is attained. Self-injurious behavior is a very powerful and reliable means of manipulation and obtaining attention. It must be remembered, however, that sometimes self-injurious behavior may be a genuine cry for help.[1]

TREATMENT

The sheer number of treatment protocols that have been attempted to address self-injurious behavior attests to the difficulty in managing the condition. There is no one method that has resulted in predictably extinguishing the behavior. A wide spectrum of self-injurious behavior severity exists and numerous treatment methods have been described. The most important consideration in managing self-injurious behavior is to tailor the treatment to the severity of the condition.

The most effective treatment is the one that addresses the cause of the self-injurious behavior. A thorough medical examination should be the first step in evaluation of self-injurious behavior.[17] Only when the underlying condition is unidentifiable or untreatable is it appropriate to use the more general symptomatic management strategies. Treatment success often depends on whether self-injurious behavior is acute or chronic.[22]

Treatments that have been tried in developmentally disabled individuals fall into three main categories: pharmacological, behavior modification, and physical restraints. Other less frequently attempted treatment modalities include psychotherapy, electroshock therapy, and even neurosurgery.[10]

Pharmacological

Most of the existing literature on pharmacological treatment of self-injurious behavior in the developmentally disabled is derived from anecdotal clinical experience.[23] Therapy has addressed the postulated defects in the dopaminergic, opiate, or serotonin systems.

Haloperidol, fluphenazine and clozapine have been used to treat the dopaminergic dysfunction, and opiate antagonists have been used to treat the possible opiate system dysfunction. Positive results have been reported from the use of noloxone or the longer acting naltrexone.[1,24] The possible role of the serotonin system in self-injurious behavior has led to the use of fluoxetine, 5-hydroxytryptophan and trazodone, all of which potentiate the action of serotonin or act as serotonin agonists.

There are several disadvantages to the pharmacological treatment of self-injurious behavior. Usually the treatment requires chronic use of the drug and few pharmacological agents are effective without sedating the individual to a considerable extent.[23,25]

Behavioral

If the etiology of the self-injurious behavior is thought to be behavioral or if such factors are supporting the activity, the removal of the reinforcing stimulus or ignoring the self-injurious behavior is the least restrictive and may be the treatment of choice in mild cases. Behavior modification methods that have been described include positive reinforcement of non-self-injurious behavior, extinction, alternative sensory activities, punishment, time-outs and overcorrection.[6] Positive reinforcement is the most frequently used behavior modification method for treatment of self-injurious behavior in the developmentally disabled.[26] Restrictive behavior modification options using various aversive stimuli have been attempted, including lemon juice, aromatic ammonia, Tabasco sauce and even electric shock.[27-30] Behavioral modification is very labor-intensive and can be difficult to implement. But the methods are often successful and present minimal risks compared to pharmacological or other more restrictive approaches.[6] Behavior modifica-

tion may not, however, be effective in the more severe cases of self-injurious behavior.[31,32]

Physical restraints

Restraints may be the only reliable means of preventing injury to the self-injurious behavior-affected individual.[26] Physical restraints include mittens, arm-boards, facial masks, helmets or restrictive clothing, but require constant wear if they are to be successful.

DENTAL MANAGEMENT

The dental management of self-injurious behavior is often difficult. Identifying the least restrictive but effective treatment can be difficult, if treatment does not resolve the self-injurious behavior. Extracting the offending teeth may have to be considered, if less invasive methods are unsuccessful.

Oral appliances

The literature is replete with reported successes and failures of preventing or inhibiting self-injurious behavior with appliances. The most common oral device used is the soft mouthguard.[16,33,34] Other appliances include bite-blocks; combination extraoral and intraoral appliances covering the chin, and held in place with a rubber band around the head, or with a headgear neck-strap; and various types of shields that guard the tongue and lip from injury.[15,35-38] Acrylic trays designed to force the lower lip anteriorly, seated on or wired to the lower teeth, have been described.[16,22,39,40] Lip-bumpers soldered onto orthodontic bands or stainless steel crowns have been reported.[22,41]

Dental extractions

Treatment of self-injurious behavior may require extraction of all the teeth.[14,32,37] Seldom does the extraction of only the offending tooth/teeth prove adequate to remedy the problem. The affected individual will often use the remaining teeth to continue the self-injurious behavior.

Osteotomy

Maxillary and/or mandibular osteotomies have been suggested as a treatment for some resistant cases of self-injurious behavior. This can provide a functionally satisfac- tory result without significantly compromising esthetics.[42]

CASE REPORT

A fourteen-year, two-month-old diminutive, nonverbal, nonambulatory, institutionalized white female was referred to the University of North Carolina School of Dentistry by her local dentist for evaluation of involuntary self-mutilation of the lower lip. Her medical history was remarkable for a devastating neurological and seizure disorder, secondary to brain damage resulting from meningitis in infancy.

Several months earlier the patient had spontaneously started strong, tonic biting motions that trapped the lower lip lingually of the maxillary anterior teeth. Facial expression by the patient suggested that she felt pain upon biting the lip, but the sensation appeared to stimulate additional involuntary biting. This resulted in significant bilateral soft-tissue trauma and infection, with loss of normal lip architecture (Figure 1).

The patient was receiving 2 mg of diazepam QID to relieve the biting action with limited success. Other daily medications included lactulose, multivitamins with fluoride, and erythromycin for the lip infection.

Intraoral examination was completed with moderate difficulty, but revealed an intact permanent dentition with only a few small carious lesions. Oral hygiene was good with only marginal gingivitis. Radiographs were not available.

The clinical impression was uncontrolled, involuntary oral mutilation, secondary to tonic biting. The child's mother wanted no teeth extracted, if at all possible. Alternative preventive measures were discussed with the child's caregivers. Several days later the child was taken to the hospital operating room where a comprehensive oral examination was completed, using general anesthe-

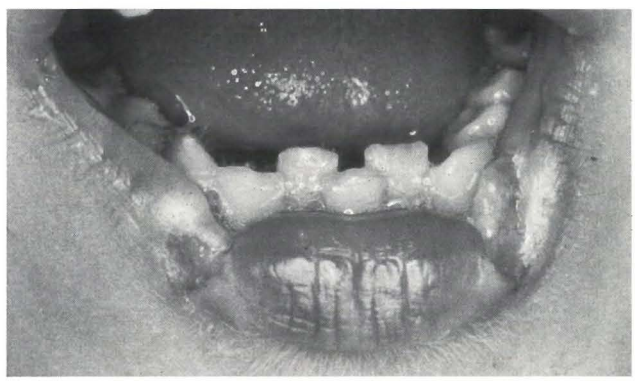
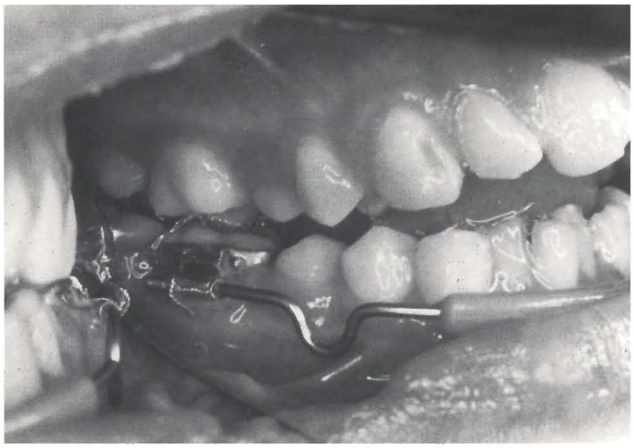
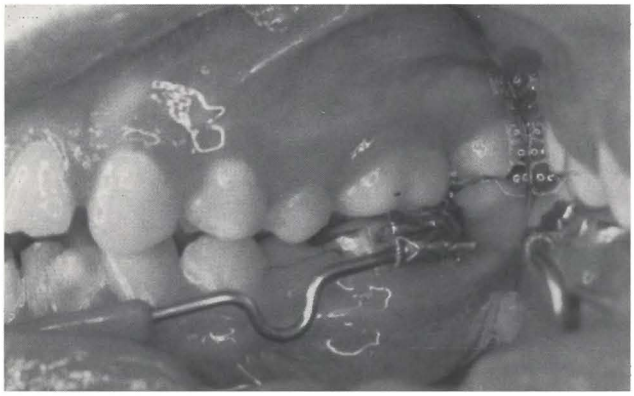


Figure 1. Extensive lower lip trauma as the result of uncontrolled self-injurious behavior.



a.



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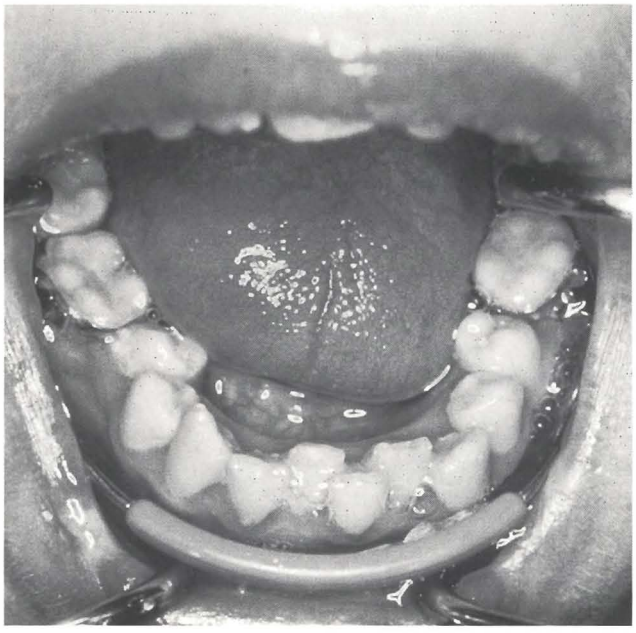

b.

Figure 2a, 2b and 2c. Modified removable lip-bumper ligated into the molar buccal tubes to stabilize the appliance.

sia. Intraoral radiographs also were taken. The teeth with caries lesions were restored and occlusal fissure sealants were placed on all noncarious premolars and molars.

An appliance was planned to prevent the lower lip from being drawn into the mouth lingually of the maxillary incisors. Orthodontic bands with 0.045 buccal tubes were adapted and cemented to the mandibular first permanent molars with zinc phosphate cement. A modified lip bumper was inserted into the mouth and secured to the buccal tubes using orthodontic ligature wires (Figure 2).

The patient returned for postoperative evaluation fifteen days following placement of the appliance. The lip lacerations were healing with no evidence of additional trauma or infection. The caregivers reported that the device was successfully preventing the lower lip from being drawn into the mouth, and no episodes of additional trauma had been observed. Oral hygiene was not being significantly compromised by the presence of the lip bumper.

Recall ninety days following insertion of the appliance revealed continued healing of the lower lip, but with some deformation due to scarring. The appliance continued to be effective, and the caregivers reported no difficulty with eating or oral hygiene (Figure 3). Periodic examination will continue with the child's local dentist.

DISCUSSION

A method of treating self-injurious behavior using a removable lip-protruding device constructed at chairside is described. The advantages of using an appliance of the type described are several. There is no need for an impression to be taken and no lab construction is required. The appliance may be removed and reinserted as needed to treat transient or periodic self-injurious be-

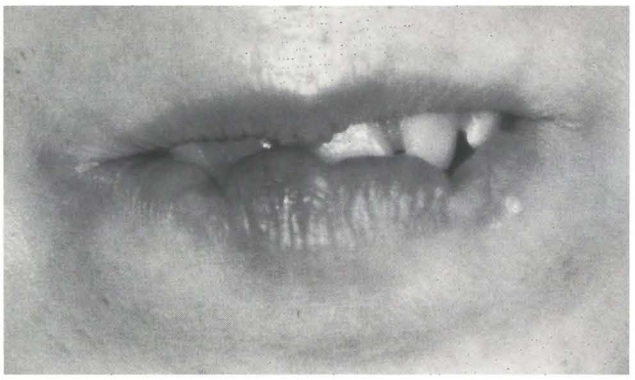

Figure 3. Ninety days post-insertion of appliance. The prevention of the self-injurious behavior has permitted significant healing with some scarring.

havior. The appliance presents minimal interference with oral hygiene procedures. Some limitations of this type of appliance include possible orthodontic tooth movement, if the appliance is worn for an extended period, and dexterous patients can dislodge or bend the appliance with their hands. We conclude that a lip-bumper may be a viable option in treating transient and acute episodes of self-injurious behavior involving the lower lip and buccal mucosa.

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INFANT CARIES

Clinical outcomes for nursing caries treated using general anesthesia

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Mark Moss, DDS, PhD
Ronald J. Billings, DDS, MSD
Philip Weinstein, PhD

Contemporary clinical management of advanced nursing caries is often accomplished using general anesthesia, an expensive treatment modality that is not without risk. Limited information is available concerning outcomes of patients receiving general anesthesia.[1-4] Legault *et al* found that 38.6 percent of all children treated required dental treatment within 15.6 months.[3] O'Sullivan and Curzon reported similar findings.[4] Information regarding treatment outcome and prognosis for nursing caries using general anesthesia, however, has not been reported. This report summarizes preliminary data to address this need. Specifically, this short communication examines the occurrence of new smooth surface caries following treatment for nursing caries using general anesthesia.

METHODS

The study sample consisted of eighty-four Medicaid-eligible children (forty-four males and forty females; twenty-one to sixty-eight months of age), who were consecutively admitted to the Ambulatory Surgical Center of Strong Memorial Hospital (Rochester, NY) for treatment of nursing caries utilizing general anesthesia.

The criteria for establishing a diagnosis of nursing caries required both of the following findings:

- ☐ The patient had smooth surface caries lesions affecting two or more of the primary maxillary incisors (caries was defined as visible extension of a lesion into dentin);
- ☐ The patient had a history of bedtime and/or naptime use of a nursing bottle (containing a cariogenic substrate) past twelve months of age (data regarding feeding history was obtained by interviewing the parent or legal guardian).

Utilizing these criteria, all of the children were evaluated and diagnosed with nursing caries before their admission to the ambulatory surgical center by Dr. Berkowitz.

All parents or legal guardians indicated that cariogenic nursing bottle feedings had ceased before their child's admission to the ambulatory surgical center.

Every child was scheduled for a follow-up evaluation at four to six months postdischarge from the surgical center. Follow-up evaluations were performed by Dr. Berkowitz. For the purpose of this report, relapse was defined as the presence of a new smooth surface caries lesion(s) that visibly extended into dentin.

RESULTS

Of the eighty-four children treated for nursing caries utilizing general anesthesia, 71.4 percent (60/84) did not present for their scheduled follow-up visits. Among the twenty-four children who presented for follow-up evaluation, 54.2 percent (13/24) had new smooth surface caries lesions that visibly extended into dentin. While there was a tendency for children who relapsed to be younger (mean age=38.8 months) than those who did not (mean age=45.3 months), this was not statistically

significant ($p = 0.29$). Statistical comparisons also demonstrated no significant differences by gender as a risk factor for relapse ($p = 0.97$).

DISCUSSION

These findings indicate that approximately two of three children in this study who were treated using general anesthesia for nursing caries were nonresponsive to conventional follow-up care. This poor compliance has been observed in other reports.[1,2] For example Roberts notes that while preventive advice is always given in the hospital setting to the parents, only a minority return for follow-up preventive therapy.[1] Roberts notes further that after treatment is completed parents did not see the need for homecare prevention and failed to keep visits for this purpose.[1] Sheehy *et al* presents complementary findings: continued post-general anesthesia caries risk was associated with "unfavorable" eating patterns, marginal fluoride exposure, and unsupervised daily tooth brushing.[2] Further study is needed from a socio-behavioral perspective to clarify the reasons for the poor rate of compliance with follow-up. Clearly the dental beliefs of the parents and their evaluations of the importance and efficacy of the proposed follow-up visits influence compliance. On the other hand, poor communication and lack of rapport and continuity of care increase the likelihood that patients will fail to comply. Few clinicians may acknowledge that their behavior may contribute to the problem.[5] Moreover, the tertiary care setting itself does not appear to foster high-quality patient relationships.

While patient, provider, and organizational variables may conspire to compromise follow-up care, there are interventions that may enhance compliance. Behavior modification has been applied to compliance problems in medicine with some success; a ready-made technology that includes contracting, commitment enhancement, and reinforcement procedures awaits us.[6]

The very high (13/24) relapse rate observed at four to six months in those patients compliant with follow-up was of concern. It is possible that this observation is applicable to the sixty noncompliant patients. Should selection bias have played a major role, however, so that only those patients with caries sought follow-up care, the 6-month relapse rate for the entire patient population, given the best case scenario, would be 15.5 percent (13/84). Given the morbidity and cost of treating relapse, even a 15.5 percent relapse rate raises serious concerns regarding the effectiveness of treatment.

Therapeutic approaches to minimize risk for relapse must address the control of etiologic risk factors. Nursing caries is known to be microbiologically characterized by dense oral populations of mutans streptococci.[7] Studies indicate that restorative dentistry has minimal impact on oral levels of mutans streptococci.[8] This indicates that the high and rapid relapse rate observed in this report is biologically plausible.

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Seeking an answer to a nagging problem

As clinicians our primary objectives in treating children suffering from dental caries are:

- ☐ **Relieve the patient of pain**
- ☐ **Remove infection**
- ☐ **Restore the teeth to normal function**

In the short-term we may consider our responsibility fulfilled. In the long-term, however, those steps represent only the beginning of a greater responsibility: Maintenance of the dentition and prevention of additional damage.

After examining the data obtained from the small study population, the authors are plagued by the fact that a high percentage of the children were not returned for observation, instruction, and, as shown by the needs of those who did return, further treatment.

The authors are thinking that a better approach to the treatment of children with infant caries would be to use strategies that use antimicrobial therapy and modify behavior.

You are invited to send your comments to the authors or to the Editor, ASDC, 875 N. Michigan Avenue, Suite #4040, Chicago, IL 60611-1901; e-mail asdckids@aol.com

DEMOGRAPHICS

Changes in families and getting youngsters to the dentist

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

When I was a child, my mother took me to the dentist for an appointment. My father worked, my mother "did not work" —she *only* did the shopping, cleaned the house, did the laundry, cooked the meals, raised the children and did the hundred and one other things that mothers did who "did not work." That was more than a half century ago, before we learned that the proper "P.C." terminology for comparable "family labor" performed by mothers (and fathers) should be "not remuneratively employed." That was a time when for many of us, the term "family" meant "a father, a mother and children."

But in the 1990s, "there is no such thing as a typical family" and for tens of millions of children, (including millions of preschool age children) "mom is out working."[1]

Previous presentations in the *Journal of Dentistry for Children* reviewed Bureau of the Census data through the mid and late 1980s, which indicated that:

- ☐ Relatively fewer of us are living in family households, particularly "traditional" nuclear families, than did in the earlier decades of this century.
- ☐ Women are bearing fewer children and they are doing so later in their reproductive years.
- ☐ Those who live in family households, live in less stable, more heterogeneous families than did previous generations.
- ☐ ". . .more than half of all children are likely to experience a period of living with a single parent during the 1990s. . ."
- ☐ A vast array of organized child care facilities, care in the child's home or that of another family member, as well as supervised care at the place of employment has developed to meet the needs of employed parent with youngsters.[1-3]

Since my mother "did not work" she could bring me to the dentist for an appointment. In today's world, who is available to chaperon the youngsters for their dental checkups and treatment when both mom and dad are working (i.e. remuneratively employed)?

As you consider the question for your patients with working parents, you must review the realities:

- ☐ Child care programs often do not have the flexibility and/or means to shepherd their charges for health services.
- ☐ There may not be two parents present in the family to juggle dental appointments and work schedules.

If pediatric dentists are to practice successfully in this rapidly evolving world of family structures, the first step must be to recognize the magnitude of the change and associated consequences. To this end, using a series of recent reports by the U.S. Bureau of the Census, the following presentation will update (through the mid-1990s) and provide further in-depth analysis of the changing composition of family* and household** structures.[4-7]

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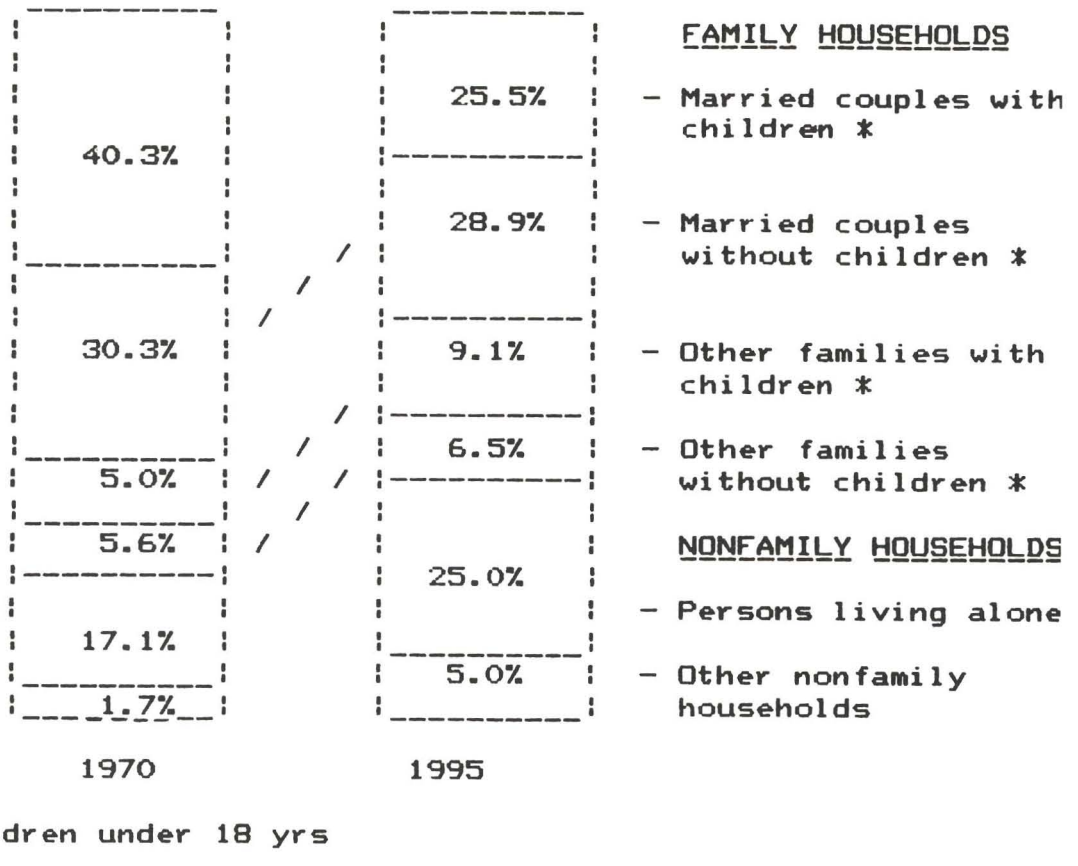

Figure. Household composition: 1970, 1991.[5,8]

THE CHANGING FAMILY AND HOUSEHOLD

"In the 1970s and 1980s, we had a big shift from married couples with children to one-parent families and people living alone."[8] But these changes in the American family structure appear to have leveled off in the 1990s.[8] Since 1970, the number of married couples with children shrank from 40 percent of all households to 26 percent in 1990 and 25.5 percent in 1995 (Figure).

- ☐ Only about one-half of U.S. families had one or more children present in the home in 1994. 1982 was the most recent year in which a majority of families included at least one child.
- ☐ The number of married couple families with children decreased by almost 1.0 million between 1970 and 1990 and their share of all households decreased by 14 percent. Since 1990, however, there was an increase of more than a half million married couple families (521,000). There has been no change since 1990, however, in the proportion of all married couple families that have children—approximately 47 percent.[5]

NUMBER OF CHILDREN IN A FAMILY

In 1994, 13.8 million families had only one child, compared to 9.4 million in 1970. Somewhat similar increases were reported for families with two children during this same period (an increase from 8.9 million to 13.8 million families).

By contrast, the number of larger families with three or more children decreased from 10.4 million in 1970 to 6.5 million in 1990, but with a rebound to 7.1 million in 1994 (Table 1).

*A family is a group of two persons or more (one of whom is the householder) related by birth, marriage, or adoption and residing together.

**A household consists of all persons who occupy a housing unit. A house, an apartment or other group of rooms, or a single room is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters.[5]

Table 1 ☐ Family household composition by presence and number of own children: 1970, 1994.[5]

	1970	1994
	(in millions)	
Family households	51.5	68.5
No children	22.7	34.5
1 child	9.4	13.8
2 children	8.9	13.8
3 + children	10.4	7.1
Married couple family	44.7	53.2
No children	19.2	28.1
1 child	8.2	9.5
2 children	8.0	10.2
3 + children	9.3	5.4
Other family — female householder	5.5	12.4
No children	2.6	4.8
1 child	1.0	3.6
2 children	.8	2.5
3 + children	1.0	1.6
Other family — male householder	1.2	2.9
No children	.9	1.6
1 child	.2	.8
2 children	<.1	.4
3 + children	<.1	.1

Table 2 ☐ Children by presence of parents, race and Hispanic origin: 1970, 1994.[4]

	Percent		Number	
			(in millions)	
	1970	1994	1970	1994
White				
2 parents	89.5%	76.2%	52.6	41.8
1 parent	8.7	20.9	5.1	11.4
Neither parent	1.8	3.0	1.1	1.5
African-American				
2 parents	58.5	33.3	5.5	3.7
1 parent	31.8	57.1	3.0	6.4
Neither parent	9.7	9.5	.9	1.0
Hispanic*				
2 parents	77.7	63.4	3.1	6.0
1 parent	na	31.8	na	3.0
Neither parent	na	4.7	na	.4

*May be of any race

SINGLE PARENT FAMILIES

One of the most important changes in the composition of the American family has been the marked increase in the number of single parents.

"The rise of the single parent has had a profound impact on the life experiences not only of those parents, but also of their children, related family members, and the public at large."[5]

Overall

The number of single parents increased from 3.8 million in 1970 to 6.9 million in 1980 and 11.4 million in 1994.

- ☐ About three out of ten (31 percent) of all parent-child living arrangements were accounted for by one-parent situations in 1994, compared to 13 percent in 1970.
- ☐ Mothers accounted for the vast majority of single parents (86 percent in 1994). There are about 9 million family households with children present in 1994 that were maintained by mothers alone (7.6 million) or fathers alone (1.3 million) (Table 1).

By race and Hispanic origin

In 1994, 11.4 million white children, 6.4 million African-American children and 3 million Hispanic (may be of any race) children lived in single-parent families (Table 2).

- ☐ 7.3 million or 64 percent of all single parents in 1994 were white. The incidence of one-parent situations in 1994, however, is much higher among African-Americans than whites (65 percent for African-Americans compared to 25 percent for whites, comparable proportions in 1970 were 36 percent and 10 percent). In 1994, there were 3.6 million single African-American parents, up from 1.1 million in 1970 (Table 3).
- ☐ Single fathers are more common among whites than African-Americans. In 1994, fathers accounted for 16 percent of white single parents versus 8 percent among African-Americans.[5]
- ☐ In 1980, two-parent families represented approximately three-quarters of Hispanic family groups with children. By 1994, the two-parent family proportion had decreased to 63 percent. In both periods, the majority of single-parent families were maintained by mothers (Table 3).

Divorced and separated parents

As marital circumstances of the adult population have changed, so have the living arrangements of children. Between 1970 and 1994, there was an increase from 3 percent to 9 percent in the divorce rate of persons eighteen years and over.

A decade ago, a child in a one-parent living arrangement was almost twice as likely to be living with a divorced parent as with a never married parent. In the mid-1990s, a child in a single-parent situation is about as likely to be living with a parent who had never married (36 percent) as with a parent who was divorced (37 percent).

An additional 18 percent lived (in the mid-1990s) with a parent that was separated from a spouse because of

Table 3 ☐ Family groups with children: 1970, 1994.[5]

	Percent		Number (in millions)	
	1970	1994	1970	1994
White				
Family groups with children	100%	100%	26.1	29.6
Two-parent families	89.6	75.3	23.4	22.3
One-parent families				
Maintained by mother	8.8	20.6	2.3	6.1
Maintained by father	1.1	4.1	.3	1.2
African-American				
Family groups with children	100%	100%	3.2	5.6
Two-parent families	65.6	35.7	2.1	2.0
One-parent families				
Maintained by mother	34.3	60.7	1.1	3.4
Maintained by father	.1	5.2	<.1	.3
Hispanic*				
Family groups with children	100%	100%	2.1**	4.4
Two-parent families	76.2**	63.6	1.6**	2.8
One-parent families				
Maintained by mother	23.8**	31.8	.5**	1.4
Maintained by father	.1**	4.5	<.1**	.2

*May be of any race
**1980 data
Note: differences are due to rounding

Table 4 ☐ Proportion of children living in a single-parent living situation with a separated, divorced or never-married parent: selected years 1960–1994.[4]

	Children living with a:		
Year	Separated parent	Divorced parent	Never married parent
1960	27.6%	23.0%	4.2%
1970	30.3	30.2	6.8
1980	26.7	43.8	15.2
1990	20.3	38.6	30.6
1994	18.4	37.0	35.8

Table 5 ☐ Grandchildren of the head of the household by presence of parents, race and Hispanic origin: 1994.[4]

Living arrangements	White	African-American	Hispanic*
Number (in millions)			
Total number of children	54.8	11.1	9.5
Grandchild of head of household	2.1	1.5	.5
Percent of all children	3.9%	13.0%	5.7%
Percent	100%	100%	100%
With both parents present	15.8	4.8	18.7
With mother only present	45.8	50.5	44.0
With father only present	6.7	1.6	8.0
With neither parent present	31.7	43.2	29.3

Note: the data in this table do not include grandparents living in the home maintained by the child's parent(s)
*May be of any race

marital discord or some other reason. Four percent lived with a widowed parent (Table 4).

Age at time of first marriage

In addition to the increased rate of divorce, the delay in first marriage among adults has been a major factor contributing to the growing proportion of children in one-parent living situations. The median age at first marriage in 1960 was 22.5 years for males and 20.1 years for females, compared to 26.7 years and 24.5 years, respectively, in 1994.[4]

Grandparents

In 1994, 3.7 million grandchildren under eighteen lived in the homes of their grandparents. This represented 5 percent of all children less than eighteen years. In 1994, 12 percent of children living with grandparents also had both parents living with them; 47 percent had their mother present; 5 percent had only their father living with them; and 36 percent had no parents present in the home.

☐ A greater percent of minority children than non-minority children lived in their grandparents homes, 13 percent of African-American children and 5.7 percent of Hispanic children, compared to 3.9 percent of white children (Table 5).

Unmarried couples

In 1994, there were 3.7 million unmarried couple households.† More than one-third (34.7 percent) included children less than fifteen years of age (Table 6). Note: these totals do not include the numbers of children being raised in same sex couple arrangements.

WORKING MOTHERS

"Today's married mothers are twice as likely to work full time all year than their predecessors of 20 years ago."[9]

Over the past three decades, the proportion of U.S. workers employed part-time has grown rapidly. This overall increase, however, masks a significant decrease in the rate of part-time employment by women. In ad-

†An unmarried couple household is composed of two unrelated adults of the opposite sex who share a housing unit. It may include households with a roommate, boarder, or paid employee of the opposite sex.[4]

Table 6 ☐ Unmarried couple households by presence of children: 1970–1994.[4]

Year	Total	With children under 15 years	Percent of unmarried couples with children
		Numbers in 000s	
1970	523	196	37.4%
1980	1,589	431	27.1
1990	2,856	891	31.1
1994	3,661	1,270	34.7

Table 7 ☐ Work experience of married mothers by age of youngest child: 1992.[9]

Work experience	With children 6 to 17, none younger	With children < 6	
		Total	< 3
	(numbers in millions)		
Married mothers, total	12.8	11.9	7.2
Worked in 1992	10.0	8.0	4.8
As percent of total	78.4%	67.2%	66.6%

Table 8 ☐ Work experience of married mother by race, Hispanic origin and age of youngest child: 1992.[9]

	Married mothers total	Worked in 1992	
		Number	Percent
	(in millions)		
White			
Total	21.7	15.8	72.6%
With children 6–17 only	11.2	8.8	78.4
With children under 6			
Total	10.5	6.9	66.4
< 3	6.3	4.2	66.3
African-American			
Total	1.9	1.5	79.5%
With children 6–17 only	.9	.8	82.6
With children under 6			
Total	.9	.7	76.1
< 3	.5	.4	72.1
Hispanic			
Total	2.4	1.4	57.6%
With children 6–17 only	1.1	.7	65.1
With children under 6			
Total	1.4	.7	51.8
< 3	.8	.4	48.3

dition, there is decreased propensity for women to leave full-time employment. Changes in wages, in the value of leisure and in the rate in which full-time jobs are being offered are particular contributors to this evolving trend.[10]

- ☐ More than three-quarters (78 percent) of married women with school-aged children worked during 1992; 42 percent worked full-time for the entire year.
- ☐ Two-thirds of married women with children less than six years and less than three years worked during 1992 (Table 7).
- ☐ A greater percentage of married African-American mothers of preschool and school-aged children worked, than their white counterparts. As compared to their white and African-American counterparts, a smaller percentage of married Hispanic mothers of preschool and school-aged children reported that they worked in 1992 (Table 8).

PROJECTIONS

Bureau of the Census projections indicate that between 1995 and 2010:

- ☐ The chances that a family will contain a mother, father, and children are expected to drop from 36 percent to 30 percent.[7]
- ☐ Continued growth in the number of single-parent families (an increase from 8 million families in 1995 to 9 million families in 2010), with single-parent families representing an increasing proportion of all families with children (an increase from 24 percent to 28 percent during this period).[6]
- ☐ The number of female single-parent households is projected to increase by 12 percent (from 6.4 million to 7.2 million). Similarly, the number of male single-parent households is projected to increase by 22 percent (from 1.5 million to 1.9 million) during the same period.[6]

IMPACT ON PEDIATRIC DENTAL PRACTICES

In numerous previous articles in the *Journal of Dentistry for Children*, I emphasized the evolving conditions for pediatric practices as dentists increased their services to underserved populations (i.e. the poor and minorities). The present review considers the evolving and seemingly endless variety of family settings for *both traditional and nontraditional* younger patients—ranging from families headed by single-parent working white mothers (or fathers) to African-American grandmothers, from working single Hispanic mothers (or fathers) to same sex partners, from unmarried heterosexual couples to . . . ad infinitum, with children being cared for during working hours by babysitters, child care centers, other family members, workplace arrangements, etc.—with the added fact that future prospects include increasing numbers of single-parent families.

Are there any pediatric dental practitioners who have not been confronted by scheduling difficulties for children with working parents, problems in securing accurate medical histories from that particular day's babysitter, parental/guardian authorization, home care follow-up, and a child management dilemma that requires discussion and cooperation with that same particular babysitter? If there is comfort in knowing that other practitioners are faced with similar circumstances, then be assured that these developments are (or will be) endemic throughout the profession as increasing numbers of mothers (fathers, grandmothers and other child guardians) enter the remunerative working arena, as families include two income earners, and as single parenthood becomes an increasing mainstay in our communities.

As I grew a little older, I may have been embarrassed when my mother still felt it necessary to take me to the dentist for my appointments—but it was a lot easier for the dentist. Come to think of it, with my own children grown and employed, I wonder who is available to escort my grandchildren for their dental appointments.

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DECISION-MAKING FOR SUGAR CONSUMPTION IN ADOLESCENCE

This study shows that decision-making to consume sugar in adolescence is complex. There are the immediate pleasures as well as the realisation of deferred dangers associated with sugar consumption. There are influences of past dental behaviours, dental health education and parental figures, such as the dentist, who can be made responsible for dental health after sugar is consumed. Furthermore, differences exist in the underlying cognitive structures between those adolescents who have and have not decided to exclude sucrose from their hot drinks. Those adolescents who do so appear to have the ability to convert dental health information into action by practising preventive health behaviours. Dental health professionals involved in dental health education and promotion should be aware of the complex nature of decision-making processes when negotiating health goals with adolescents.

Freeman, R. and Sheiham, A.: Understanding decision-making processes for sugar consumption in adolescence. Community Dent Oral Epidemiol, 25:228–232, June, 1997.

CASE REPORTS

CHARGE syndrome: Review of literature and report of case

Stephen E. Grimm, III, DDS
George P. Thomas, DDS

In 1979, a group of congenital anomalies were first identified by Hall.[1] This association of characteristics was given the acronym of CHARGE, each letter representing an anomaly:
C - coloboma associated with the choroid, iris, retina or optic nerve;
H - heart disease which may include tetralogy of fallot, septal defects, or valvular stenosis;
A - atresia of choanae;
R - retarded mental development (developmental delay);
G - urogenital abnormalities or male genital hypoplasia;
E - ear abnormalities/deafness.[2]

A diagnosis is made when four of the six defects are present. In the recent review of literature, Lubinsky investigated the etiology of "CHARGE association."[3] Associations were causally effected by a teratogenic agent on the developing embryo, and they differ mechanistically from multiple congenital anomalies seen in CHARGE. Lubinsky in his communication suspects CHARGE is in fact a chromosomal microdeletion syndrome. In 1995, Lee *et al* diagnosed a newborn with suspected "CHARGE association."[4] Yet, certain features as short palpebral fissures, atypical rocker-bottom feet, and clenched hands appeared to point toward a chromosomal causation. Karyotyping confirmed a diagnosis of Trisomy 18 in addition to CHARGE association. The authors purport that the dimorphic features in CHARGE are similar phenotypically to other chromosomal syndromes as incomplete/partial trisomy 13 or 4p syndrome in addition to Trisomy 18 and emphasize that any neonate, provisionally diagnosed with CHARGE, be evaluated genetically. Different syndromes levy a heavier degree of morbidity and mortality than CHARGE unless two or three of the following features are present in CHARGE: cyanotic heart disease, bilateral choanal atresia, and esophageal atresia. Incoordination in swallowing, and subsequent aspiration with ensuing respiratory failure, is the most likely cause of death in CHARGE.[5]

Cardiac anomalies present in "CHARGE association" were studied by Wyse *et al* in a group of fifty-nine patients in the United Kingdom. In this group, 85 percent had congenital heart disease with a clear predilection for right-sided heart lesions and contruncal defects. Approximately two-thirds required surgical management. There was a correlation between the prevalence of tracheoesophageal fistula and severe heart disease, most commonly Tetralogy of Fallot. Mortality was perioperatively associated. In addition, the number of congenital anomalies necessitated multiple anesthetic/surgical interventions that increased the incidence of mortality in this population of patients. The group seems to feel that the etiology in the deficiencies of neural crest migration is not totally explanatory and the chromosomal deletion and teratogenic exposure may also be conceivable operant etiologies. Management of these patients should be directed at the underlying pharyngeal incoordination

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with possible aspiration, this being the cause of death in 50 percent of the nonsurvivors. The micrognathia, tracheolaryngomalacia, anterior larynx, or subglottic stenosis present the anesthesiologist with many pitfalls in addition to the cardiac malformation.

Morgan *et al* provided a comprehensive otolaryngological examination of fifty patients with CHARGE association.[7] Ear anomalies were most often malformed pinnae (96 percent) and facial nerve palsies (54 percent). Most CHARGE patients presented with a severe or mixed loss, most causally associated with a hypoplastic incus and absent semicircular canals. Of the 86 percent with upper airway abnormalities, posterior choanal abnormalities (56 percent), retrognathia (42 percent), and laryngotracheal abnormalities (38 percent) were respectively found. Fourteen percent required tracheostomies, most of which were decannulated in two to five years.

Lacombe, in a 1993 communication, discussed the salient point that 76 percent of a sample CHARGE group had an abnormality of one cranial nerve and more than one cranial nerve was implicated in 44 percent of the group, most notably VII, VIII and IX/X relating to facial nerve paralysis, sensorineural or mixed hearing loss, and deglutition difficulties respectively.[8] Four CHARGE children presented with an asymmetric crying face suggesting hypoplasia of the depressor anguli oris muscle. Overlap with Cayler cardiofacial syndrome (hypoplasia of DAOM and cardiac malformation) was dually noted. Of interest, fluorescence in situ hybridization demonstrated a microdeletion of 22q 11.2 in CHARGE association as in DiGeorge syndrome, Velo-cardio-facial syndrome, and conotruncal cardiac malformations, which explains the variability of phenotypic expression.

In 1993, Byerly and Pauli supported facial paralysis and pharyngeal incoordination, which are important in the establishment of CHARGE as a diagnosis.[9] Cranial nerve dysfunction of VIII, VII, IX/X, III and VI were noted in decreasing respective percentages.

In 1992, Blake, Kirk and Ur found that CHARGE neonates had normal birth weights and lengths, but they fell in the centiles with age.[10] CHARGE children remained small and there was male pubertal delay.

CASE REPORT

In August of 1995, a three-year-old inpatient of a local tertiary care center was seen for routine evaluation and treatment. The custodial caretaker completed the medical history denoting a history of asthma, mental retardation, and cardiac abnormality. She was premedicated with antibiotics for S.B.E prophylaxis by the attending pediatrician. An examination with cursory prophylaxis and fluoride treatment was completed with the caretaker holding the child for passive restraint from random injurious movement. Additionally, it was noted that the child had a tracheostomy. The decision was made that the venue of general anesthesia was necessary to complete the proposed treatment plan of four occlusal amalgams and a pulpotomy-stainless steel crown. An in-depth workup with appropriate consultations was needed, therefore, before the anesthetic event.

Figure 1. Frontal photograph showing patent tracheostomy with filter. In addition, patient is post-surgical rectification of the choanae.

Reviewing the patient's complete chart, it was noted that the patient was diagnosed with CHARGE syndrome. Born thirty-six weeks EGA with a birth weight of 2910 grams, she now weighed 10.5 kg at three years and three months, falling from the normal centiles. A tracheostomy was performed in August of 1992, one month postpartum prophylactically to avert airway embarrassment and aspiration because of the prevalent features of retrognathia and, more importantly, pharyngeal incoordination. There was a positive finding of choanal atresia, moderate to severe hearing loss with low set ears (Figure 1), and congenital cardiac anomalies including Epstein anomaly, first degree AV block and right atrial enlargement. The medications included augmentin, beclomethasone, initial inhaler, sudafed p.r.n., tylenol

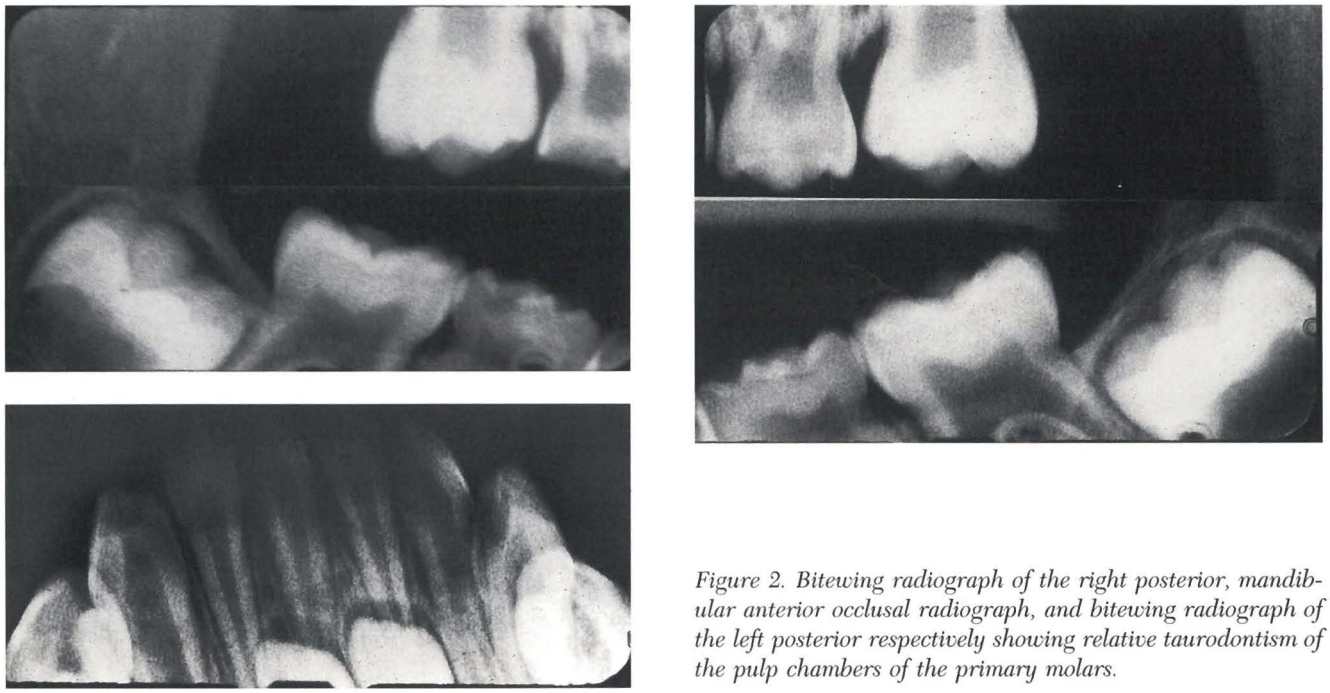

Figure 2. Bitewing radiograph of the right posterior, mandibular anterior occlusal radiograph, and bitewing radiograph of the left posterior respectively showing relative taurodontism of the pulp chambers of the primary molars.

p.r.n. and dimetapp p.r.n. with no known allergies to any medications. Developmental delay was noted, but various aforementioned factors could be contributory to this observation especially hearing loss, a large impediment in the learning process. An echocardiogram was completed confirming these salient features:

- ☐ Epstein anomaly of the tricuspid valve;
- ☐ Mild tricuspid insufficiency;
- ☐ Mild to moderate mitral insufficiency;
- ☐ Right atrial enlargement;

An electrocardiogram reported sinus tachycardia, right atrial enlargement, left axis deviation, and right bundle branch block. Our cardiac consultant integrated these findings with his examination. S.B.E. prophylaxis was paramount pre- and postsurgically. Anesthesia consulted with the patient after interpreting the data. In October of 1995, the surgical event was undertaken. Our decision was to administer the S.B.E premedication of ampicillin at 50 mg/kg, once an indwelling line was established. The patient was taken to the operating room where invasive lines were placed as well as monitoring devices. An arterial line was positioned. The anesthesia circuit was attached to the patient's tracheostomy cannula. Induced with halothane, nitrous oxide and oxygen, the anesthetic agent was later switched to isoflurane. The patient was draped and then five periapical radiographs were taken. The draping was completed as well as the placement of a 4x4 Raytec throat pack. The following teeth were restored with occlusal amalgams: teeth lettered I, L and S. Teeth lettered A, J, K and T were sealed. After these restorations were completed, the oral cavity was thoroughly cleansed of any particles. The prophylaxis and fluoride treatment were subsequently completed. Then, tooth lettered B was extracted. Hemostasis was achieved with pressure. The anesthesia was discontinued. The patient was taken to recovery in stable condition and discharged later that day. Postoperative course was uneventful. The patient was seen on follow-up one week later with no adverse subjective or objective findings.

DISCUSSION

Four of the six criteria necessary to diagnose CHARGE syndrome were present. The important dental feature is the pharyngeal incoordination and inability to handle secretions. The fear of aspiration should be heeded especially with the profession's use of water coolant spray in

our procedures. The existence of a tracheostomy aided in the office operatory treatment of this patient as well as obviated problems most often confronting the anesthesiologist on intubation. The practitioner must weigh the possibility of aspiration, if dental procedures such as operative dentistry are to be undertaken versus the possible increased morbidity or mortality associated with an anesthetic event in CHARGE patients. Additionally, choanal atresia with retrognathia (an observed 6mm of overjet) may contribute to dental anomalies:

- ☐ Vertical growth pattern;
- ☐ Mouth breathing with an open mouth habitus;
- ☐ Frontal tongue posturing;
- ☐ Maxillary arch constriction.[11]

The presence of a tracheostomy may have a beneficial effect upon airway restriction and tongue posture, averting the severity of an orthodontic malocclusion seen in CHARGE patients without a tracheostomy. CHARGE patients are decanulated in two to five years, when surgical dilation or rectification of the choanae is undertaken.

After our radiographs were developed intraoperatively, taurodontism of the pulpal chambers of the primary molars was noted (Figure 2). Besides CHARGE, other syndromes with a propensity for this hard tissue anomaly are:

- ☐ Down syndrome;
- ☐ Amelogenesis Imperfecta, Type IV;
- ☐ Ectodermal Dysplasia (hypohidrotic type);
- ☐ Oral-facial-digital syndrome II;
- ☐ Trichodento-osseus syndrome;
- ☐ Klinefelter's syndrome;
- ☐ Lowe's syndrome.[12-15]

The cardiac anomaly is replete in dental literature, yet heartily advocate the extraction of any pulpally-involved primary tooth. Failure of pulpal therapy is always imminent no matter how controlled the situation. The culpability of an ensuing S.B.E. infection is not worth the risk. Additionally, during the anesthetic event, an arterial line was used. Critical monitoring of the vasopressure was paramount considering the cardiac lesion and the possibility for arrhythmias.

Three of the four siblings born to this mother were diagnosed with CHARGE syndrome. One of the three affected has succumbed and the cause of death is unknown. This lineage supports the proposition of Lubinsky that CHARGE is syndromal in nature and of a chromosomal etiology.

CONCLUSION

In 1979, Hall described this congenital dysmorphia. Oral findings and special dental considerations of the young CHARGE patient have not been reported. The changes in the occlusion are variable depending on a variety of factors as the degree of choanal atresia and the presence of a tracheostomy. Dentally, constriction of the palate with a posterior crossbite, retrognathia, frontal tongue posturing, and taurodontism of the pulps of the primary molars may be noted. The caries history is not notable, yet a sound oral hygiene program was instituted at the tertiary care center with nursing reinforcement due to the age and developmental delay. CHARGE syndrome, once thought to be an association, is a heritable disorder, and the practitioner should be cognizant of the characteristics of this condition and establish sound treatment rationale.

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Preservation of permanent teeth in a patient with Papillon-Lefèvre syndrome by professional tooth-cleaning

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Papillon-Lefèvre syndrome is a rare autosomal recessive trait with a high degree of parental consanguinity.[1–3] The two characteristic symptoms are hyperkeratosis of palms and soles and premature loss of the primary and permanent teeth associated with severe periodontal breakdown.[4–5] Commonly all primary teeth are lost from 3.5 to 4 years of age, and usually all of the erupted permanent teeth are lost by age thirteen to fourteen years.[6] The high susceptibility to infection of the periodontium and other areas of the body has not been clearly elucidated. Dysfunctions of chemotaxis and phagocytosis have been reported.[6–8] Due to the extraordinarily high susceptibility to infection, conventional periodontal treatments, e.g., scaling, curettage, plaque control or root planing usually do not succeed in the preservation of permanent teeth.[3,9] With regular professional tooth cleaning aimed at the removal of interdental plaque and using gingival massage, however, we obtained good results in the preservation of the permanent teeth.

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The authors wish to express their gratitude to the patient and her parents for their cooperation and patience.

REPORT OF CASE

An eight-year-old girl was referred to the Department of Preventive Dentistry, Okayama University Dental Hospital. At the first consultation, her mandibular incisors and first molars, and her maxillary first molars had deep periodontal pockets (≥5 mm). The left mandibular first molar was severely mobile and a periodontal abscess was present. Her oral hygiene was very poor, and the O'Leary plaque control record was 100 percent.

HISTORY

She was healthy at birth. Her grandparents were blood relatives, though her parents were not. Her parents and brother have no general health problems. When she was two months old and afflicted with severe thrush, she was admitted to the pediatrics division of a hospital. The hyperkeratosis arose on her palms, soles, knees and elbows when she was one and a half years old. Her gingiva also became red and swollen. Her mobile teeth and strong halitosis were noticed by her mother. Her symptoms did not improve, in spite of treatments at a pediatric clinic and a private dental clinic. She was referred, therefore, to the Department

of Oral and Maxillofacial Surgery, Okayama University Dental Hospital by her family dentist.

At the first consultation in the Department of Oral and Maxillofacial Surgery, her general health was good. Remarkable erythematous keratoderma was present, however, on her palms, the dorsum of the hands, soles, knees and elbows. All primary teeth had erupted. Her oral hygiene was poor and the gingiva was generally red and swollen. Pus discharged from the deep periodontal pockets and all teeth, especially the mandibular anterior teeth, were severely mobile. Her primary teeth began to exfoliate at the age of three years and four months, despite vigorous oral hygiene instructions and regular scaling, in addition to medications of antibiotics and vitamin A. When she was four years and seven months old, she became completely edentulous and wore full dentures.[11]

Her permanent teeth began to erupt normally at six years of age. Gingival abscesses appeared again. She had been medicated with 10-20 mg/day of etretinate by the Department of Dermatology, Okayama University Medical Hospital since she was seven years and nine months old. Her cutaneous symptoms of keratoderma were remarkably reduced by the etretinate. The etretinate medication was stopped after seven months, however, because of the adverse effect of long medication; her cutaneous symptoms appeared again after three days of etretinate withdrawal. She was then referred to our clinic, the Department of Preventive Dentistry, Okayama University Dental Hospital, when she was eight years and four months old.

CLINICAL TREATMENT CONSISTED OF PROFESSIONAL TOOTH CLEANING

She has been recalled every month and her teeth have been brushed professionally, using a toothbrush and an interdental brush since being first seen at our clinic. At every visit, removal of subgingival plaque, using a curette and thin interdental brushes, was followed by periodontal pocket irrigation with 0.01 percent chlorhexidine or acrinol with added hydrogen peroxide, until she was ten years and eight months old. Since ten years and nine months of age, 0.3 percent hydrogen peroxide or 100 ppm sodium fluoride solution was used for subgingival irrigation. In addition to the professional treatments, she was trained in toothbrushing, using a special toothbrushing technique named the "toothpick method" at every visit. From the repeated picking-and-withdrawing motion of the toothbrush bristles into the interdental spaces, the removal of interproximal plaque and a massage effect on the interdental tissues were expected.[12]

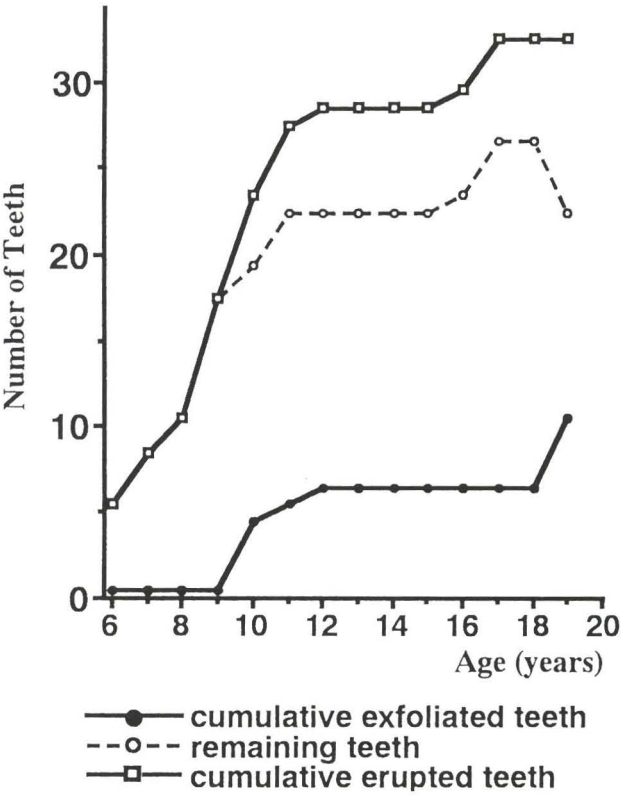

Figure 1. Numbers of erupted, exfoliated and remaining permanent teeth.

PRESERVATION OF PERMANENT TOOTH

Due to the extensive training, her plaque control record decreased until she became nine years of age.[10] Her plaque control record increased again, however, from ten to thirteen years of age. Her permanent teeth began to exfoliate at ten years of age. Beginning at fourteen years of age, the plaque control record continuously decreased again and the exfoliation of teeth ceased for five years until the age of eighteen. At age nineteen, however, her teeth began to exfoliate again and she lost an additional four teeth. Up to nineteen years and seven months of age, a total of ten permanent teeth were exfoliated, and twenty-two teeth were preserved (Figure 1). She has worn a lower partial denture since nineteen years and seven months of age.

Among the ten exfoliated permanent teeth, eight were mandibular and only two were the maxillary first molars (Figure 2). The shortest retention period of the exfoliated permanent teeth was two years and ten months for the mandibular right lateral incisor. Among the remain-

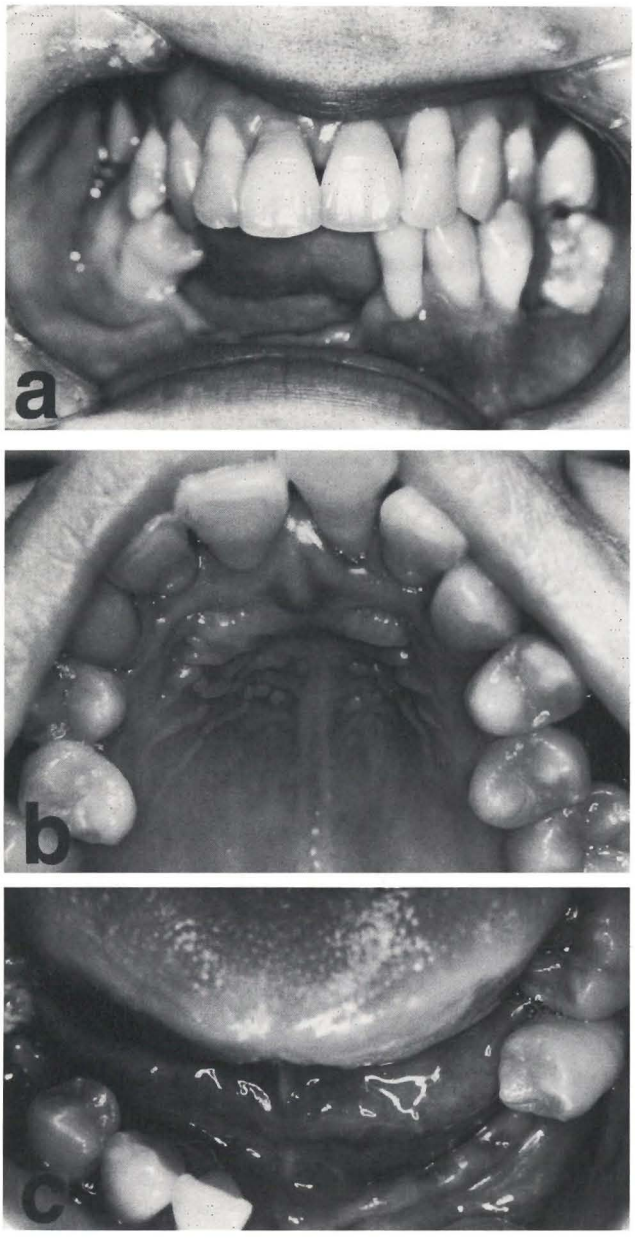

Figure 2. Intraoral photographs of the patient at age nineteen years and seven months. a: front, b: maxilla (mirror image), missing 16 and 26, c: mandible (mirror image), missing 31, 35, 36, 41, 42, 43, 44 and 46.

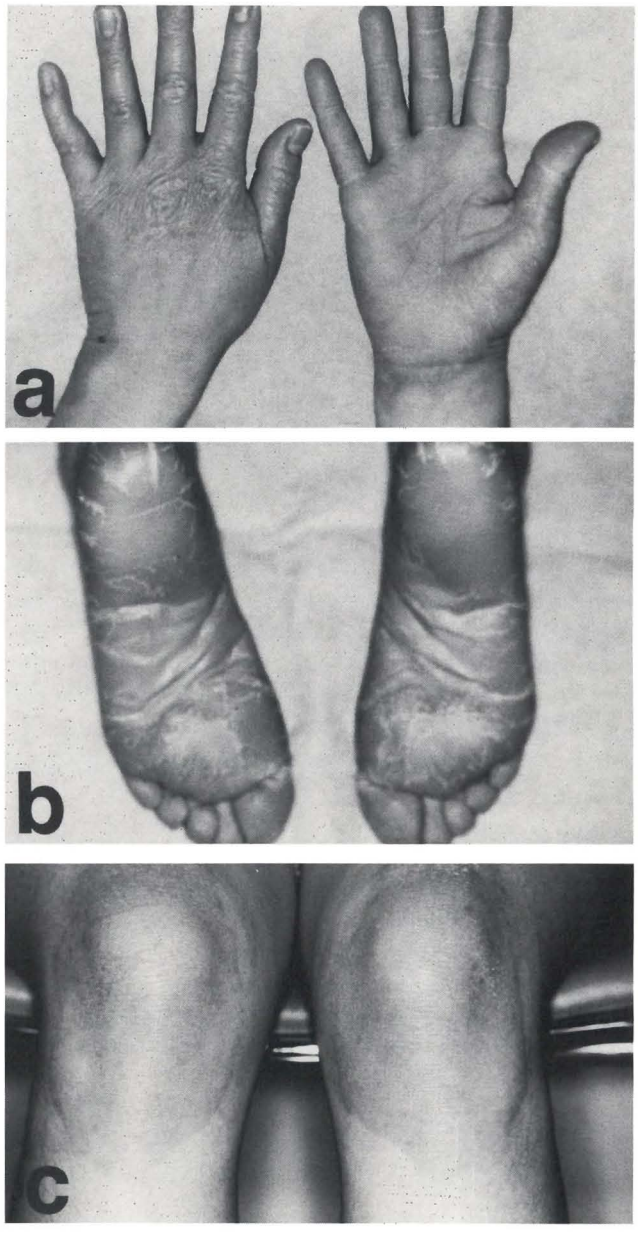

Figure 3. Hyperkeratosis lesions of the patient at age nineteen years and seven months. a: palms and dorsum of hands, b: soles, c: knees.

ing teeth, the longest retention was twelve years and seven months for the maxillary right and left central incisors at the age of nineteen years and seven months.

On the other hand, the hyperkeratosis on the palms, the dorsum of the hands, soles and knees has remained up to nineteen years (Figure 3).

DISCUSSION

Our case showed that regular professional tooth cleaning could, although imperfectly, preserve permanent teeth in a Papillon-Lefèvre syndrome patient with little medication. The toothbrushing method employed at home and in the clinic was evaluated in order to achieve ben-

eficial reduction of pathogenic bacteria at the interproximal areas and gingival sulcus. Furthermore, the gingival massage resulting from mechanical stimulation by toothbrushing was assessed to improve the immunity through the keratinization of gingival tissue and providing stimulus for an adequate blood supply.

Most of the case reports of conventional periodontal treatments for a patient with Papillon-Lefèvre syndrome do not succeed in the preservation of permanent teeth.[3,9,13,14] Bimstein *et al* treated a fourteen-year-old girl with Papillon-Lefèvre syndrome.[3] Endodontic treatment and periodontal curettage were performed. Only six maxillary teeth remained and a full lower denture was provided at fifteen years of age. Hathway treated a ten-year-old boy.[9] No great improvement occurred. All first molars were extracted despite regular scaling and intensive oral hygiene therapy. It was inevitable that the patient soon become edentulous. Conventional periodontal treatments combined with tetracycline medication were also applied to Papillon-Lefèvre syndrome patients with permanent dentitions.[13,14] Most permanent teeth were lost, however, within a few years.

Many investigators used tetracycline or retinoic acid (etretinate or acitretin) for Papillon-Lefèvre syndrome patients.[2,15-17] Preus treated two Papillon-Lefèvre syndrome siblings (fourteen and eleven years of age) with tetracycline, following extractions of periodontally involved teeth.[15] Fifteen months after treatment, the children had no signs of periodontitis. Gelmetti *et al* reported the preservation of all permanent teeth in a Papillon-Lefèvre syndrome patient up to twenty years of age by etretinate therapy.[16] For four years, they medicated the patient with etretinate, beginning at nine years of age, a few weeks after the eruption of the delayed permanent dentition. All permanent teeth were free of periodontal symptoms for six years after etretinate withdrawal. Ishikawa *et al* treated two female patients (ages four and seven).[17] In the younger patients, all primary teeth were extracted and all permanent teeth erupted with healthy periodontium. The older patient did not improve, however, after periodontal and antibiotic (minocycline or erythromycin) treatments. These studies show that timely medication and total eradication of bacteria before the eruption of permanent teeth can achieve good results. Baer and McDonald proposed that in order to preserve all permanent teeth, primary teeth should be extracted by three years of age followed by tetracycline therapy.

Since we began to treat the patient with advanced periodontitis of the mixed dentition by the aid of professional tooth cleaning, total eradication of pathogenic bacteria by the extraction of all teeth could not be employed. When she visited our department at the age of eight years and four months, the alveolar bone supporting the mandibular molars had already resorbed (Figure 4a). Antibiotic medication was not employed to avoid the adverse effects of long-term medication. The etretinate therapy was stopped for the same reason before referral to our department. Until the age of nineteen years and seven months, ten permanent teeth were lost (Figure 4b). The professional tooth cleaning, consisting of toothbrushing by the "toothpick method" and subgingival plaque removal, however, was judged to obtain somewhat better results than conventional periodontal treatments, including scaling, curettage and oral hygiene instruction, using other toothbrushing techniques.

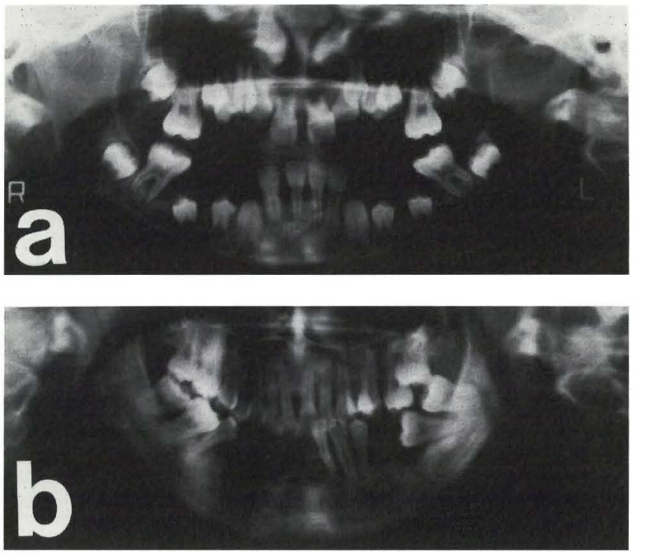

Figure 4. (a) Orthopantomographs of the patient at age eight years and one month. (b) nineteen years and seven months. a: Alveolar bone of mandibular right and left molars has already resorbed. b: Teeth 17, 18, 27, 28, 37, 38, 47 and 48 were migrated mesially.

Unfortunately, the alteration of chemical agents used for subgingival irrigation could not identify specifically the effect of a single chemical modality. Chlorhexidine, an antiplaque agent, has been most widely used in periodontal treatment.[19] The Japanese Welfare Ministry has prohibited the oral use of chlorhexidine application, however, since a case of an allergic reaction was reported. Hydrogen peroxide, an oxidative antiseptic for controlling specific bacteria, was a discouraging agent because of its carcinogenicity.[20] Irrigation with sodium fluoride was employed to prevent root surface caries.

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HYBRIDS

It can be concluded that hybrid restorative materials show a pronounced diversity in their physical and mechanical characteristics. They exceed conventional glass ionomers in fracture strength and fatigue resistance. However, they remain inferior to resin composites in the characteristics of primary importance for a universal dental restorative material. The great diversity between the different brand names may indicate that the optimum composition of these promising new restorative materials has yet to be reached. Several properties need to be improved significantly. Ranked on a continuum between purely salt-matrix conventional glass ionomers and purely resin-matrix resin composites on the basis of the present results and those reported in the literature (Burgess *et al.*, 1994; Cao *et al.*, 1994; Mitra, 1994; Friedl *et al.*, 1995; Swift *et al.*, 1995b), the polyacid-modified resin composites, Dyract, Geristore, and Variglass, most closely approximate resin composites. Fuji II LC, Ionosit-Fil, Photac-Fil, and Vitremer are true resin-modified glass ionomers, with Photac-Fil more closely approximating the conventional glass ionomers.

Gladys, S. *et al*: Comparative physico-mechanical characterization of new hybrid restorative materials with conventional glass-ionomer and resin composite restorative materials. J Dent Res, 76:883–894, April 1997.

ABSTRACTS

Waldman, H.B.: Child abusers, the abused, and the murdered: in our nation and your state. J Dent Child, 64:169-175, May-June 1997.

In an effort to alert pediatric dental practitioners to the ongoing epidemic of child victimization and murder, a review provided of Department of Justice and Department of Health and Human Services reports, including data on the perpetrators of these crimes and a state by state review of these criminal events.

Child abuse; Murder; Abusers

Jongenelis, A.P.J.M. and Wiedemann, W.: A comparison of plaque removal effectiveness of an electric versus a manual toothbrush in children. J Dent Child, 64:176-182, May-June 1997.

The purpose of this study was to test the plaque-removing efficacy of an electric brush (Philips HP550) in comparison with a manual brush (Butler Gum 111) in five- to ten-year-old uninstructed children. The sample included twenty-three children who were divided into two groups, each group brushing for four weeks with the assigned brush at home. After this period children were asked to brush for two minutes in a dental clinic. Plaque was scored according to the Turesky modified Quigley and Hein Index before and after brushing. Analysis shows that plaque reduction with the electric brush is significantly better than with the manual brush: 46 percent versus 25 percent reduction, respectively. Results are most marked for the lingual posterior areas. Results further indicate that using an electric brush, plaque is reduced more evenly over the dentition. Participants without previous experience with powered toothbrushes showed no problem in adapting to the electric brush.

Plaque; Electric toothbrush; Manual toothbrush

Kielbassa, Andrej M.; Wrbas, Karl-Thomas; Hellwig, Elmar: Initial tensile bond strength of resin-modified glass ionomers and polyacid-modified resins on perfused primary dentin. J Dent Child, 64:183-187, May-June 1997.

The objective of this study was to evaluate the initial tensile bond strength of a resin-modified glass ionomer (Photac®-Fil) and two polyacid-modified composite resins (Compoglass®, Dyract™) to primary dentin. A hybrid composite resin (Tetric®) and two chemical cured glass ionomers (BaseLine®, Hi-Dense®) served as controls. Ninety caries-free dentinal discs were ground flat and perfused with Ringer's solution. Dentinal surfaces were conditioned (except for BaseLine®). From each material, fifteen standardized specimens were attached to the dentin. Light-curing of the respective materials followed (1 min), and adhesion was tested with a universal testing machine 15 min after application. The highest initial bond strength was observed with Tetric® (5.17 MPa). Closed test procedure (Kruskal-Wallis) showed significant differences between all materials ($P < 0.05$), except for Compoglass® (1.82 MPa) vs. Dyract™ (2.35 MPa), and BaseLine® (0.37 MPa) vs. Photac®-Fil (0.42 MPa). The condensable glass ionomer Hi-Dense® revealed a mean tensile bond strength of 0.79 MPa. Adhesion of (polyacid-modified) composite resins is superior to the other tested glass ionomer materials, when applied to perfused primary dentin.

Tensile bond strength; Resin modified glass ionomer; Primary dentin

Needleman, Howard L.; Ku, Tsao-Chuen; Nelson, Linda; Allred, Elizabeth; Seow, W. Kim: Alveolar bone height of primary and first permanent molars in healthy seven- to nine-year-old children. J Dent Child, 64:188-196, March-April 1997.

The purpose of the study was to establish baseline values of the alveolar bone height of the primary molars and first permanent molars in sample of healthy U.S. seven- to nine-year-old children. Direct measurements of the distance from the cementoenamel junction (CEJ) to the alveolar crest (AC) on 223 pairs of bitewing radiographs from 223 subjects were made using a digimatic caliper under standardized conditions. The distance from the CEJ to the AC had medians from 0.58mm to 1.39mm (range 0.0 to 4.44mm) for the primary molars and from 0.00mm to 0.64mm (range -1.35 to 2.15mm) for the mesial aspect of the permanent molars. There were no statistically significant differences in the distance from CEJ to AC between teeth on the right and left sides of the mouth. The distances from CEJ to AC were always greater in the maxilla than in the mandible for similar primary molar sites, but only true for the mesial aspect of the permanent first molar at age nine. As a tooth is positioned more anteriorly in the mouth, the distance from CEJ to AC was greater. On the whole, males had greater distances than females and eight-year-olds had larger distances than seven- or nine-year-olds. Differences were observed in the measured distances for the different age and sex-groups and may be attributable to variations in eruption and exfoliation patterns. The distance was significantly greater in areas of interproximal restorations and open contacts, and there was a tendency for the distances to be greater in areas of interproximal caries.

Alveolar bone; Children

Downs, Angela Templeton; Dembo, Jeffrey; Ferretti, Gerald *et al*: A comparative study of midazolam to meperidine/promethazine as an IM sedative technique for the pediatric dental patient. J Dent Child, 64: 197-200, May-June 1997.

This study evaluated the efficacy and safety of midazolam (0.2mg/kg) as an IM sedative agent in the pediatric population as compared to the standard IM meperidine (2.0mg/kg)/promethazine (1.0mg/kg) sedation technique. Ten pediatric

continued on page 228

ABSTRACTS CONTINUED

dental patients, ASA Class I, were evaluated in this double-blind, randomized, crossover study. The patients ranged in age from two to four years. Vital signs, sedation levels, and anxiety levels were evaluated. Midazolam was shown to be safe, but the inferior drug compared to the standard IM meperidine/promethazine sedation technique.

Midazolam; Meperidine/promethazine

Hölttä, Päivi; Aine, Liisa; Mäki, Markku *et al*: Mutans streptococcal serotypes in children with gastroesophageal reflux disease. J Dent Child, 64:201-204, May-June 1997.

It has been suggested that vomiting acid gastric contents in bulimia might favor oral growth of *Streptococcus sobrinus*. We studied the colonization of *Streptococcus sobrinus* (serotypes g and d) and *Streptococcus mutans* (serotypes c, e and f) in sixteen children, ages five to fifteen years, who had suffered for four to eleven years from gastroesophageal reflux, another condition with recurrent acid regurgitation. Our aim was to find out if the prevalence of *Streptococcus sobrinus* would be higher also in this patient group. Mutans streptococci were detected in twelve out of sixteen (75 percent) study patients of the saliva samples cultured on MSB agar. For the Mutans streptococci positive children healthy controls were matched by salivary levels of mutans streptococci and age as closely as possible. From each child three to six isolates representing both *Streptococcus mutans* and *Streptococcus sobrinus* (n = 103) were serotyped by immunodiffusion method. The distribution of serotypes in the study/control group was: c: 7/10; e: 4/2; f: 0/1; g:3/2; d:0/0. One strain in the study group remained untypable. All patients infected with *Streptococcus sobrinus* were also infected with *Streptococcus mutans*. Our results indicate the great similarity in the distribution of ms serotypes in the gastroesophageal reflux children and their healthy controls. The data do not suggest that the acid regurgitation would have an influence on the prevalence of *Streptococcus sobrinus*.

Gastroesophageal reflux; *Streptococcus sobrinus*; Serotypes

Sæmundsson, Sigurður Rúnar and Roberts, Michael W.: Oral self-injurious behavior in the developmentally disabled: Review and a case. J Dent Child, 64:205-209, May-June 1997.

Self-injurious behavior occurs in conjunction with a variety of psychiatric disorders as well as various developmental disabilities and some syndromes. The behavioral and biochemical aspects of self-injurious behavior are poorly understood and several etiologies have been suggested. Treatments for self-injurious behavior in developmentally disabled individuals fall into three main categories: pharmacological, behavior modification and physical restraints. The dental management of self-injurious behavior is often difficult. Numerous appliances of various design have been reported in the literature. Osteotomies or extraction of the offending teeth may have to be considered if less invasive methods are unsuccessful.

A case is reported where a child engaged in tonic lip biting secondary to a neurological and seizure disorder is treated using a removable lip-protruding device. No impression or lab construction is required. The appliance presents minimal interference with oral hygiene procedures and it can be removed and reinserted as needed. We conclude that a removable lip-bumper may be a viable option in treating transient and acute episodes of self-injurious behavior involving the lower lip and buccal mucosa.

Berkowitz, Robert J.; Moss, Mark; Billings, Ronald J. *et al*: Clinical outcomes for nursing caries treated under general anesthesia. J Dent Child, 64:210-211, May-June 1997.

This study did follow-up examinations of 84 Medicaid-eligible children with nursing caries after they received treatment for nursing caries utilizing general anesthesia. Results at six months suggest that parents are unresponsive to follow-up care and over half of the children seen had new smooth surface caries lesions. While results are preliminary, they suggest that major changes are needed in the tertiary care of children with nursing caries.

Nursing caries; Parental concerns

Waldman, H.B.: Changes in families and getting youngsters to the dentist. J Dent Child, 64:212-217, May-June 1997.

Bureau of the Census surveys for the mid-1990s, with projections into the early years of the next century, indicate a continuing increase in the numbers of single-parent families, grandparent supervised children, families with two employed parents and a wide variety of child care arrangements. Pediatric dentists increasingly will need to deal with juggled parental work schedules, unavailability of parents/guardians and any number of difficulties resulting from changed family structures in both traditional and non-traditional patient populations.

Single-parent families; Pediatric dental care

Grimm, III, Stephen E. and Thomas, George P.: CHARGE syndrome: Review of literature and report of case. J Dent Child, 64: 218-221, March-April 1997.

Because of the medical characteristics of this inheritable disorder, the treatment of these patients can be fraught with potential pitfalls. Oral manifestations can include taurodontism of the pulp chambers, retrognathia, palatal constriction with attendant posterior crossbite, frontal tongue posturing, and mouth breathing relating to airway restriction from choanal atresia. The authors describe their treatment of a patient three years of age with a tracheostomy.

CHARGE syndrome; Taurodontism