Dental caries in HIV-infected children versus household peers: Two-year findings

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Abstract

Purpose: This report will present a two-year comparison of the incidence and baseline prevalence of dental caries found in both the primary and permanent dentition among a cohort of HIV-infected children as compared to household peer control subjects who were not HIV-infected.

Methods: The subjects in this report were from an initial cohort of 171 children (104 HIV positive and 67 HIV negative), who were participants in the Children's Hospital AIDS Program in Newark, New Jersey, from 1993-1995. This two year analysis reports the findings on the children who completed baseline through Year 02 examinations (N=121), aged 2-15 years old (68 HIV positive, 53 HIV negative).

Results: While the DMFS incidence at Year 02 among the 6-11 year old control subjects was 17% higher than that of the HIV-infected cases (2.1 vs. 1.8, respectively) this same incidence was eight-fold higher for the control subjects among the 12-15 year olds (e.g., 8.1 vs. 1.0, respectively). The mean cumulative dmfs score to date for HIV-infected cases was higher than for the control subjects for both the 2-5 year olds and the 6-11 year olds, (11.0 vs. 7.0) and (10.0 vs. 4.0, P=.02), respectively. In all three age groups, HIV-infected cases had a greater number of primary teeth and fewer number of permanent teeth than the control subjects (P<.01).

Conclusion: Given that HIV-infected cases had lower DMFS scores and higher dmfs scores than their household peer controls, the fewer mean number of permanent teeth among the HIV-infected cases suggests that this delayed tooth eruption pattern in permanent teeth contributed to the lower DMFS scores seen in the HIV-infected cases. (Pediatr Dent 22:207-214, 2000)

Prior to 1992 when this study was initiated, information about dental caries in HIV-infected children was very limited.[1] Of the published articles on the oral manifestations of AIDS, virtually all addressed this issue only in an adult population. In one of these studies HIV-infected adults had a lower prevalence of dental caries than a comparison group of healthy adults from the same region of Zaire.[2] Another adult study found that there was an association between dental caries and *Capnocytophaga* keratitis.[3] A Russian study found a high incidence of dental caries in symptom free HIV-infected adults.[4] It was not until the late 1980s that investigators started to turn attention to the oral manifestations of HIV-infected children, but none of those earlier writings reported on the disease of dental caries.[5-7] Between 1992 and 1996 there were three published cross-sectional studies of dental caries in the primary teeth of HIV-infected children.[8-10] These studies showed that there was a higher prevalence of dental caries (including ECC) in the primary dentition of HIV-infected children as compared to healthy children. However, in a 1996 case control study of caries prevalence in a group of children aged 1.5 to 12 years, Teles, G et al. (1996) reported a lower dmft for HIV-infected children ($P<0.00$) as compared to healthy children, as well as a higher DMFT ($P<0.01$).[11] There is no clear description of the healthy comparison group of children in this study except for the fact that they were a "medium" 0.6 years older than the HIV-infected cases. There is no way then, to know if they shared common environmental factors. More recently, Vieira, et al., (1998) reported that HIV-infected children (aged 2-12 years), who were more immunologically affected (CD4:CD8 < 0.5 ratio) showed a greater DMFT/dmf index than HIV-infected children who were immunocompetent.[12] Among these same children, those with a gingival index equal to zero had lower DMFT/dmf ratios than children with a gingival index score greater than 0.1. Although this report gives a more recent account of the caries profile of HIV-infected children it does not offer a comparison with a group of non-infected controls.

To date there are no published longitudinal descriptive studies comparing HIV-infected pediatric cases with a control. The purpose of this report is to compare the baseline prevalence and two-year incidence of dental caries found in both the primary and secondary dentition among a group of HIV-infected children as compared to their HIV-negative household peers.

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Methods

Subjects

In 1992, a population of HIV-infected children, who were under pediatric medical care at Children's Hospital AIDS Program (CHAP) in Newark, New Jersey, now referred to as the Francois-Xavier Bagnoud Center at UMDNJ, were invited to participate in a multi-year follow-up study along with their household peers to serve as controls. Study enrollment took place from June, 1993 through May, 1994.

Table 1. Overall Population Compliance with Study Dental Examination Schedule

	All subjects	Control subjects	HIV-infected	Death due to AIDS
Baseline N=171	100%	100%	100%	—
6-mos N=153	90%	94%	87%	5%
12-mos N=142	83%	90%	79%	12%
18-mos N=126	74%	84%	67%	16%
24-mos N=121	71%	79%	65%	19%

Pearsons χ^2=.22

The control subjects (e.g., household peers), were selected by the following criteria: 1) categorized as HIV-negative by the medical team; and 2) living in the same household as the HIV-infected case. In some instances there were multiple household peers, who were neither gender nor age matched to the experimental group. All controls were considered to be healthy upon pediatric medical examination, and consisted primarily of natural siblings (66%), some of which were half brothers and sisters (28%) all living together with the HIV-infected child in the home of a mother or grandparent. Still others were natural born children of foster parents unrelated to the HIV-infected child (6%). Specifically, 94% of the control study subjects were categorized as HIV-negative by the ELIZA (HIV) test with the remaining 6% judged to be HIV-negative by report, e.g., they were the natural born children of foster parents who had taken the HIV-infected child into their home, for whom the doctors decided that there was no reason for testing.

The subjects were categorized into three baseline age groups: 2-5 year olds, 6-11 year olds, and 12-15 year olds. These three age groups were selected as they reflect the tooth eruption status of the child (e.g., the primary dentition stage, the mixed dentition stage, and the permanent dentition stage). Children were categorized into one of three racial/ethnic groups: African American, Caucasian, and Hispanic. During the course of this study, no information on the use of fluoride was obtained nor was there any standardized intervention or treatment performed; however, all subjects found to be in need of dental care were referred to the Pediatric Dental Clinic at UMDNJ-NJDS for treatment. Considerable effort was made to assist families in making those dental appointments. Compliance to study appointment and referral examinations was documented throughout the study and was been reported elsewhere.[13] As the first longitudinal study to compare dental caries in HIV-infected children with a control group of non-infected children, this study was not designed to achieve statistical significance, but rather to utilize all available HIV-infected children under treatment at the CHAP clinic. This population, therefore, represents a convenience sample in which subjects were classified by CD4 lymphocyte counts, a standard surrogate marker for disease progression and mortality in children at that time.[14] This report presents the two-year results of dental caries in the primary (dmfs) and permanent (DMFS) teeth of HIV-infected pediatric subjects as compared to a control group consisting of their household peers.

Dental examination

Having obtained the appropriate Institutional Review Board approval for this research project, all examinations were conducted in a dedicated clinical dental research facility at the UMDNJ-New Jersey Dental School. After informed consent had been obtained for each subject, three calibrated dental examiners performed the clinical examinations for dental caries, using a #23 dental explorer and a mouth mirror. Calibration was established, at 90% agreement prior to study examinations, by comparing the results of clinical examinations of children to an experienced Radike[15] calibrated examiner, the criteria used for the diagnosis of dental caries in this study. As this study included periodontal and soft tissue examinations in addition to the dental caries examination, a single dental visit took approximately 30-45 minutes. Parents or guardians of the children received a $25 monitory voucher to compensate them for time and travel expenses at each dental examination. Follow-up examinations occurred at 6-month intervals during the first two years. All subjects who had completed the baseline examination were enrolled into the study.

Statistical analysis

Caries and tooth eruption analysis were determined by using ANOVA, 2-tailed statistics for differences between HIV sta-

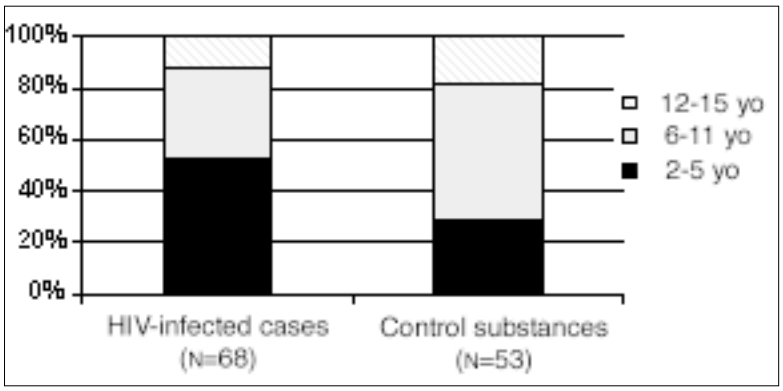

Fig 1. Distribution of children who completed the Year 02 examination by age group HIV status. Pearson χ^2=0.02

Table 2. Two-year dmfs Incidence by Age Group and HIV Status

	2-5 year olds		6-11 year olds		12-15 year olds	
	Cases N=36 Mean age (3.3±1.1)	Controls N=15 Mean age (3.3±1.1)	Cases N=24 Mean age (7.7±1.5)	Controls N=28 Mean age (8.0±1.8)	Cases N=8 Mean age (13.3±.9)	Controls N=10 Mean age (13.4±1.0)
Baseline•	8.2±18.0	3.5±8.2	13.9±16.1	5.0±6.2••	.0±.0	.3±.9
Year 2•	11.0±18.2	6.7±14.4	10.0±11.6	4.0±6.0••	.0±.0	.0±.0
2-year increment	2.8±8.9	3.3±8.0	-3.8±9.6	-1.0±3.3	.0±.0	-.3±.9

dmfs represented by mean±1 SD.
•Significant difference between HIV status within specified time period,
••Significant difference within particular age groups for specified time periods, ANOVA, $P<.05$.

tus groups at a .05 level of significance. The Chi-Square analysis was used to assess differences in age and compliance to study examinations between the two groups.

Results

Demographics

Of all the parents and guardians of children who brought their children to the CHAP clinic, 95% agreed to participate in the Pediatric AIDS Study. Of the initial population of 202 HIV-infected case and control subjects identified as being eligible by age for participation, 85% agreed to participate in this oral health study. All children in this participating group of 171 (104 HIV-infected, 67 HIV-negative) received baseline dental caries examinations. The racial/ethnic composition of the baseline study subjects was 83% African American; 2.5% Caucasian; and 15% Hispanic. At the Year 02 examination, 71% (N=121) of the children—68 HIV-infected, and 53 HIV-negative subjects—completed the study visit. There was an overall loss of 35% of HIV-infected children and 21% of the controls over the 2-year observation period.

Table 1 shows the overall study population's compliance with the five scheduled study examinations. The first column shows that the percentage of all subjects (e.g., cases and controls) at any one of the five dental visits was 71% or greater. The next two columns clearly show a lower compliance with the examination schedule among the HIV-infected cases at each examination, as compared to the controls. However, after accounting for the attrition due to deaths of the HIV-infected cases, as seen in the last column, study exam compliance was nearly equal and statistically insignificant among the two groups (χ^2=0.22). Of the 36 HIV-infected children who were lost to the study prior to the Year 02 examination, 19 children had died, 2 children were hospitalized and too ill to be examined at the Year 02 examination, and 15 had moved or were lost to follow-up contact. Of the 14 household-peer controls who were lost to the study prior to the Year 02 examination, 3 had dropped out of the study after the death of their HIV-infected household peer and 11 had moved or were otherwise lost to follow-up contact. However, when the analysis of compliance with the scheduled examination was limited only to general non-compliance reasons (e.g., neither death nor AIDS-disease related), the loss was similar for the cases and the controls (e.g., 14% vs. 16%, respectively). Thus, this report presents the two-year dental caries findings on those 121 subjects (e.g., the 65% of cases and the 79% of controls who completed the Year 02 examination).

Fig 1 shows the final distribution of study subjects by age group for the Year 02 analysis. The unequal distribution of subjects within age-groups by HIV status (e.g., 53% of the cases, but only 28% of the controls, were 2-5 year olds) resulted in the fact that the HIV-infected cases were approximately 18 months younger than the control subjects (P=.02). Specifically, the overall mean age for the HIV-infected cases at baseline was 6.0±3.6 years while the mean age for the household peer controls at baseline was 7.7±3.8 years.

Caries incidence and prevalence

Tables 2 and 3 presents the 2-year mean dmfs and DMFS incidence within age groups, respectively, for the 121 case and control subjects in this analysis. Table 2 shows that the 2-year incidence for dmfs among the 2-5 year old control subjects was

Table 3. Two-year DMFS Incidence by Age Group and HIV Status

	2-5 year olds		6-11 year olds		12-15 year olds	
	Cases N=36 Mean age (3.3±1.1)	Controls N=15 Mean age (3.3±1.1)	Cases N=24 Mean age (7.7±1.5)	Controls N=28 Mean age (8.0±1.8)	Cases N=8 Mean age (13.3±.9)	Controls N=10 Mean age (13.4±1.0)
Baseline•	.03±.3	.0±.0	1.2±1.8	1.5±3.9	4.0±6.5	6.5±5.7
Year 2•	.08±.3	.07±.3	3.0±4.9	3.6±5.7	5.0±5.8	14.6±14.7
2-year increment	.06±.2	.07±.3	1.8±3.3	2.1±2.9	1.0±2.1	8.1±10.7

DMFS represented by mean±1 SD.
•Significant difference between HIV status within specified time period, ANOVA, $P<.05$.

Table 4. The Number and Percent of Subjects with Caries-free Primary and Permanent Teeth by Age Group and HIV Status, at Year 02

	2-5 year olds		6-11 year olds		12-15 year olds		Overall Totals	
	Cases Mean age (3.3±1.1)	Controls Mean age (3.3±1.1)	Cases Mean age (7.7±1.5)	Controls Mean age (8.0±1.8)	Cases Mean age (13.3±.9)	Controls Mean age (13.4±1.0)	Cases N=68 Mean age (6.0±3.6)	Controls N=53 Mean age (7.7±3.80)
Subjects with caries-free primary teeth	16 (59·)	9 (29·)	3 (11·)	12 (39·)	8 (30·)	10 (32·)	27 (40·)	31 (59·)
Subjects with caries-free permanent teeth	33 (73·)	14 (58·)	10 (22·)	9 (38·)	2 (4·)	1 (4·)	45 (66·)	24 (45·)
Subjects with caries-free primary and permanent teeth	14 (74·)	8 (57·)	3 (16·)	5 (36·)	2 (11·)	1 (7·)	19 (28·)	14 (26·)

· Number (Percent)

18% higher than that of the HIV-infected cases, while among the 6-11 year olds there was a decline in caries incidence nearly 4-fold greater for the HIV-infected cases as compared to the controls. Table 3 presents the 2-year DMFS incidence within age groups. The DMFS incidence was higher in all age groups for the control subjects than for the HIV-infected cases. While the 2-year DMFS incidence among the 6-11 year old control subjects was only 17% higher than that of the HIV-infected cases (2.1 vs.1.8, respectively) this DMFS incidence was eight-fold higher for the control subjects among the 12-15 year olds (e.g., 8.1 vs. 1.0, respectively).

Fig 2 shows the cumulative mean dmfs and DMFS score within age groups for the study subjects at the Year 02 examination. Among the 2-5 year olds and 6-11 year olds, the mean dmfs score was higher for HIV-infected cases as compared to the control subjects (11.0 vs. 7.0, and 10.0 vs. 4.0, respectively). Of these differences observed, only the difference in dmfs for the 6-11 year olds was statistically significant (P=.03). Among the 6-11 year olds, the control subjects had a 20% higher mean DMFS score than HIV-infected cases of comparable age (e.g., 3.6 vs. 3.0, respectively) while the mean DMFS score among 12-15 year olds was nearly 3-fold higher for the control subjects as compared to the HIV-infected cases (e.g., 14.6 vs. 5.0, respectively). A similar analysis assessing dmft and DMFT gave similar results but further, illustrates the number of teeth involved in the overall caries experience for all subjects (Fig 3).

Table 4 shows the number of subjects with caries-free primary or permanent teeth. Overall, the number of HIV-infected cases with caries-free permanent teeth was 88% greater than the number of control subjects with caries-free permanent teeth. The inverse was true for the primary teeth. The number of HIV-infected cases with caries-free primary teeth was 15% less than the number of control subject with a caries-free primary dentition.

Presence of primary and permanent teeth

A separate analysis of the mean number of primary and permanent teeth within age groups revealed that, HIV-infected cases had a higher mean number of primary teeth than did control subjects. This ranged from the largest difference of 3.8 more primary teeth for 2-5 year olds (P=.03) to 1.8 more primary teeth in the 6-11 year old age group to the smallest

Table 5. The Number of Subjects with 6-year Molars Present and the Percentage of Subjects with Unerupted 6-year Molars at a Baseline Age of 6-7 Years by HIV Status

	HIV-infected cases (N=12)		Control subject (N=12)	
Tooth	# of cases with tooth present	Percent of cases with tooth absent	# of controls with tooth present	Percent of controls with tooth absent
3 Mean age	6 7.0±0.0	50%	10 6.4±.52	17%
14 Mean age	5 6.8±.45	58%	9 6.4±.53	25%
19 Mean age	7 6.7±.49	42%	9 6.4±.53	25%
30 Mean age	7 6.7±.49	42%	10 6.4±.52	17%

Table 6. The Number of Subjects with 4 Primary Incisor Teeth Present and the Percentage of Subjects with Those Teeth Missing at a Baseline Age of 6-7 Years by HIV Status

	HIV-infected cases (N=12)		Control subject (N=12)	
Tooth letter	# of cases with tooth present	Percent of cases with tooth absent	# of controls with tooth present	Percent of controls with tooth absent
E Mean age	7 6.4±.53	42%	4 6.3±.50	67%
F Mean age	7 6.4±.53	42%	6 6.3±.52	50%
O Mean age	3 6.3±.58	75%	2 6.0±.00	83%
P Mean age	4 6.3±.50	67%	2 6.0±.00	83%

observed difference of 1.4 more primary teeth for the 12-15 year olds. Regarding the permanent teeth, for the 6-11 year olds, HIV-infected cases had 4.5 fewer permanent teeth than the controls (12.9 vs.17.4, *P*=.01), while among 12-15 year olds the HIV-infected cases had 2.3 fewer permanent teeth (24.9 vs. 27.2, *P*=.10) than their controls (Fig 4).

Table 5 shows the number of subjects within their HIV status who, at a baseline age of 6-7 years, had the six-year molars (e.g., teeth 3,14,19, and 30) present in the mouth. Overall, for all four teeth there were more HIV-infected cases than controls with those teeth absent from their dentition (a mean 48% vs. 21%). Within the specified age range of 6-7 there was a significant difference between the mean age of the cases and the controls for which the upper right first molar was present (*P*=.01). Table 6 shows a similar comparison for the presence of four primary incisors (e.g., teeth E, F, O, and P). The control subjects had a higher percentage than the HIV-infected cases of those teeth absent (either exfoliated or already replaced by the permanent tooth). Just as was the case with the six-year molars, the HIV-infected cases with these teeth present in the mouth were shown to be older than the control subjects (0.1-0.3 years older).

Discussion

The analysis of caries data at the Year 02 examination showed differing patterns for the primary and the permanent teeth when the HIV-infected children and their HIV negative household peers are compared. The overall prevalence of dental caries in the primary dentition was higher among HIV-infected cases than for the household-peer controls, (*P*=.03; Table 2). The opposite was true for the prevalence of dental caries in the permanent dentition (e.g., HIV-infected cases had an overall lower DMFS score as compared to the HIV negative household peer control group) (*P*=.01; Table 3). For this study population, however, over the 2-year follow-up period an increased incidence in caries was seen in the control group of subjects. Altogether, there was a near 3.8-fold increase in dmfs incidence (e.g., .49±5.7 vs. .13±9.6) and 2.3-fold increase in DMFS incidence (e.g., 3.7±6.4 vs.1.6±3.0) among the control subjects as compared to the HIV-infected cases. Inasmuch as the control group represented a population most like the HIV-infected cases, (e.g., 94% natural siblings or stepbrothers and sisters), it is unlikely to suspect that the differences in dmfs and DMFS scores were due to any social differences between the two groups.

Madigan, et al., (1996) found in a cross-sectional study that there was a higher prevalence of dental caries in the primary teeth of HIV-infected children as compared to their HIV negative sibling, and in particular among children older than 6 years of age (7-14 years). In another comparison of dental caries and stage of disease among the HIV-infected children, the Madigan, et al. (1996) study concluded that perinatally HIV-infected children (especially those with advanced disease) had a higher prevalence of dental caries in the primary dentition than HIV-infected children with less advanced disease. Those findings are in agreement with our findings, in that our HIV-infected cases displayed an overall higher dmfs score in Year 02 than the control subjects, with the only statistically significant difference in dmfs score, by age group, seen among HIV-infected cases and controls in the 6-11 year old age group.

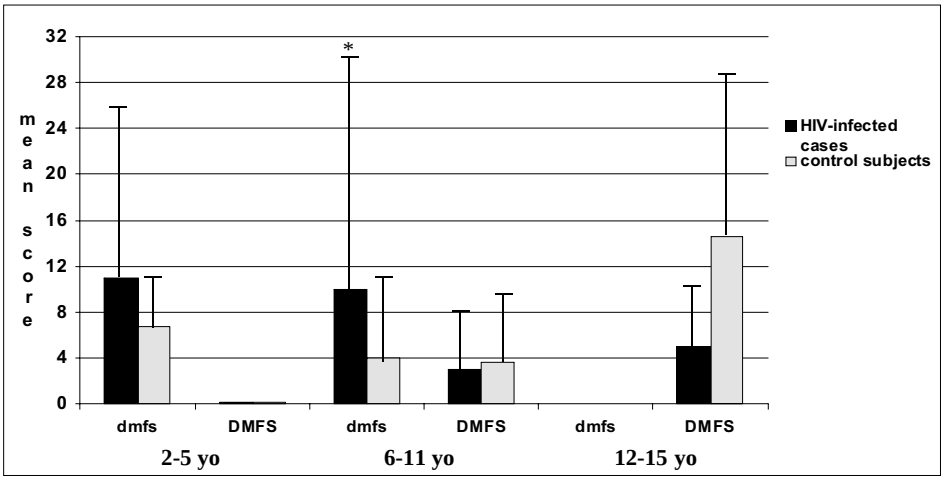

Fig 2. Mean dmfs and DMFS by HIV status within age groups at the Year 02 examination. Mean±SD, as represented by the bars. Asterisk represents a significant difference from control subjects within age group. Overall differences in dmfs and DMFS for the two groups were significant, ANOVA, *P*<.05.

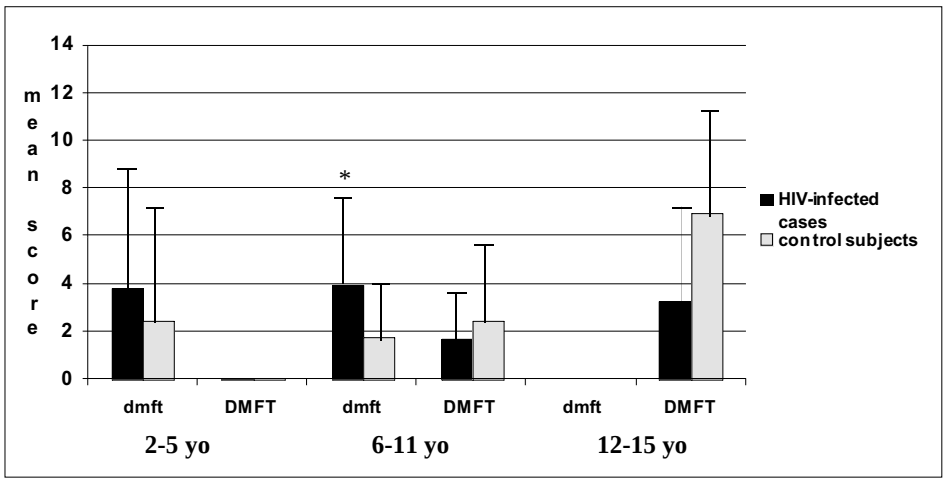

Fig 3. Mean dmft and DMFT by HIV status within age group at the Year 02 examination. Mean±SD, as represented by the bars. Asterisk represents a significant difference from control subjects within age group. Overall differences in dmft and DMFT for the two groups were significant, ANOVA, $P<.05$.

Valdez, et al., (1994) also reported a higher prevalence of dental caries (dft) in primary teeth of HIV-infected children (mean age 4.9±0.38) when compared to the national average for five-year-olds. Valdez et al found that dental caries in the primary dentition of HIV-infected children was nearly 2.6-fold higher than the U.S. national average of 1.7.

In a group of 1-11 year-old HIV-infected children, (mean age 5.5) Howell, et al., (1992) reported a high prevalence of dental caries in the primary teeth, especially in those children aged five years of age or younger, when compared to a sample of healthy children. Howell, et al., (1992) found that 45% of 55 HIV-infected subjects presented with extensive dental caries (at least 10 surfaces decayed), while the remaining 55% of subjects presented with little (less than 10 surfaces) or no caries in the primary dentition (e.g., dmfs was 29.9 vs. 2.0, respectively). The findings of both Valdez, et al., (1994) and Howell, et al. (1992), for younger HIV-infected children are also in agreement with the Year 02 results of this study. At the Year 02 examination, there was evidence in our study of a higher dmfs among HIV-infected cases represented in the 2-5 year old age group (mean age 3.3±1.1 years) and when one considers the mean dmfs for combined age groups 2-5 year olds and 6-11 year olds (mean age 5.6±2.7 years) the evidence is still clear that there was a higher dmfs prevalence for HIV-infected cases than for control subjects (10.6 vs. 5.0, respectively).

DMFT was the index measure used to score permanent tooth dental caries both in the Madigan, et al. (1996) and the Valdez, et al. (1994) studies of children aged 1-14 years old and 2-11 years old, respectively. When Madigan, et al. (1996), compared DMFT of HIV-infected children to that of HIV negative siblings, they found that for children older than 6 years there was a 19% higher mean DMFT for HIV-negative siblings as compared to the HIV-infected children. The direction of caries findings in that study was the same as the Year 02 findings in this present study. In this study, at Year 02, among children in the two older aged groups, DMFS and DMFT was found to be higher for the control subjects than for the HIV-infected cases. Although these were not statistically significant findings, the nearly three-fold higher DMFS score seen in our study among control subjects in the 12-15 year old age group (mean age 13.3 years) represents a large clinical difference (e.g., 14.6 vs. 5.0, respectively). Further, the DMFS for both case and control subjects in this age group was higher than the national average (4.8) for 13 year-old U.S. school children.[16] The limitation of this finding in this older group is that it represents a sample size too small (10 subjects) to draw any definitive conclusions. However, this finding does strongly suggest that there is the need for larger future studies in cariology among this age group.

Valdez, et al. (1994) reported that HIV-infected children, in mixed dentition, exhibited a DMFT score 1.5-fold higher than the national norm (0.8) for 9 year olds, and thus found that the prevalence of permanent tooth caries was higher among the HIV-infected children than the comparison group comprised of a national sample. The mean DMFS and DMFT results at the Year 02 examination for HIV-infected cases in the mixed dentition stage (mean age 7.7) proved to be higher than the national average (.79 and .59, respectively) for 8 year olds.[16] The DMFS for this group was 3.8-fold higher while the DMFT score was 2.8-fold higher than the national average. However, these scores were not higher than those of a comparable group of control subjects.

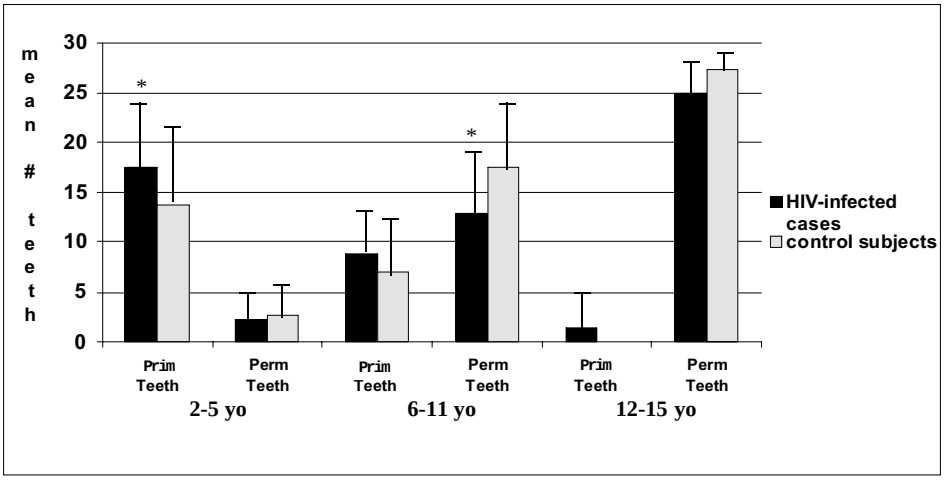

Fig 4. Mean number of primary and permanent teeth by HIV status within age group at the Year 02 examination. Mean±SD, as represented by the bars. Asterisk represents a significant difference from control subjects within age group. Overall difference in the number of primary and permanent teeth for the two groups was significant, ANOVA, $P<.05$.

The Year 02 caries scores for the primary teeth were higher for the HIV-infected cases than for the control subjects in all age groups where there were primary teeth present. Possibly this occurs because of the long-term exposure of primary teeth to inappropriate feeding habits or elixir type medications and nutritional supplements routinely given to HIV-infected children, as some investigators have suggested.[8,9,17,18] However, this would not explain why the permanent teeth of older children among the HIV-infected cases were less affected by caries than the control subjects unless those dietary or medication exposures only occurred during the early years of life.

Conversely, over the course of the study it can be seen that among the three age groups those aged 6-11 years showed the greatest decline in dmfs incidence. When the HIV-infected cases are compared to the controls in this age group, the decline in incidence was greatest for the HIV-infected cases (28% vs. 20%, respectively). Future analytical studies in cariology will be needed to further determine both the etiologic factors and their timing to explain these observations.

Overall, our findings showed that in every age group, HIV-infected cases had a greater number of primary teeth and a fewer number of permanent teeth than their comparable aged controls (e.g., HIV-infected cases had prolonged retention of the primary teeth and delayed eruption of the permanent teeth). This assessment became more evident when the data was examined for the presence of specific teeth, (e.g., six-year molars). In a sub-group of children, which included all who were aged 6-7 years (12 HIV-infected case, 12 household peer controls), there was a higher percentage of HIV-infected cases with each of those teeth absent from the mouth than the control subjects. Those HIV-infected cases that did have those teeth present were also older than the controls. In comparison to the chronology of the human dentition set forth by Logan and Kromfeld[19] (1949), and the works of other investigators such as that of Garn, et al.[20] (1973), who studied the age at emergence of the permanent tooth, these findings would suggest that there was a delayed eruption pattern for the six-year molars among the HIV-infected children in this sub-group. Garn, et al. (1973) suggest a mean age range of 5.73-6.40 years for the eruption of the six-year molars. The mean age for the presence of the six-year molars, within the chosen age range of 6-7 years in this study (as also suggested by Logan and Kromfeld, 1949), was 6.4 years for the control subjects for all four of the six-year molars. HIV-infected cases had an averaged mean age of 6.8 years for the presence of the same four teeth. The results for the presence of four primary incisors, although not significant, interestingly enough suggests that some delay in the exfoliation of primary teeth exists among the HIV-infected cases in this age group.

These findings are in agreement with earlier studies[9,21-23] that noted some delay in the eruption pattern of children who were HIV-infected. For example, Valdez, et al. (1994) found delayed eruption in 31% of his population of HIV-infected children when panoramic radiographs were compared against well-known tooth development charts. In another study, Del Toro, et al., (1996) found two patients with what appeared to be delayed tooth development. One of these cases was a 37 month-old child with only 12 erupted teeth, which included 8 primary incisors and 4 primary first molars.

It should be noted that care of HIV-infected children involves a complexity of care management,[24] which includes guarding the overall health of an infected individual. Conditions may exist that either make oral hygiene measures difficult to perform or difficult to maintain. For instance, a majority of these children live in one-parented households where mothers try to cope while relying on public assistance for health care and financial support.[25] These families may live in areas where the DMF index is already high, or be members of households where oral hygiene is generally poor. These families have also encountered problems in being compliant with the keeping of dental appointments as has been noted by a previous investigation.[13] Whatever may be the case, it has not always been clear from past studies exactly what factors bring about these differences that exist in dental caries between HIV-infected children and a non-infected control group. In this present study there seems to be a common environmental factor that has placed both cases and controls at risk for dental caries.

Past studies make note of a high caries prevalence among the HIV-infected children but the comparison has been to general populations of healthy children. This present study shows that not only are the caries scores high for HIV-infected cases, but also they are high for a group of household peers as well when compared to the national norm as previously stated. Therefore, this study does agree with past investigators that the Year 02 prevalence of dental caries in the primary dentition was higher among HIV-infected cases when compared to children who were non-infected. Further, this analysis, in agreement with the cross-sectional studies of others, gives evidence that both the overall Year 02 prevalence and two-year increase in caries incidence in the permanent teeth of healthy non-infected children was higher than that for children who were HIV-infected.

Future studies in cariology will be necessary to investigate and determine the tooth eruption pattern in both the primary and permanent teeth of HIV-infected children and how this pattern of eruption might affect the dental caries profile of the teeth. Given the general consistency of the unfolding descriptive epidemiological picture of dental caries in HIV-infected children, further studies should focus on identifying specific extrinsic etiologic risk factors, as well as the effect of intrinsic risk factors such as eruption patterns. One factor to measure would be the affect of age on eruption patterns considering how difficult it is to match HIV-infected cases to control subjects by age. Another approach might be to examine the duration of erupted tooth exposure to the oral cavity before caries occurs.

Conclusions

1. HIV-infected children have a high prevalence of dental caries in the primary teeth and a low prevalence in permanent teeth while the incidence of permanent tooth dental caries is less than that of a group of non-infected household peers.
2. Some percent of the decrease seen in DMFS among HIV-infected children is due to the lower mean number of permanent teeth present in the mouth.
3. HIV-infected children aged 6-9 are more likely to be older and have a greater percent of retained primary incisors and absence of permanent first molars than a comparable group of non-infected household peers.

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