



Dental caries in HIV-infected children: a longitudinal study

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Abstract

Purpose: The purpose of this descriptive longitudinal clinical study was to determine primary and permanent dentition caries status in HIV-infected children, and to compare caries status with the CD4 percentage (CD4%) and immune suppression category.

Materials and methods: 73 children up to 9 years of age with vertical HIV transmission were evaluated for caries in the primary dentition at baseline and at 6 month intervals over a 30 month period; while 19 HIV-infected children between 5 and 11 years of age had their permanent dentition evaluated for caries at baseline and at 6 month intervals over a 24 month period. Caries status was also compared with CDC CD4 percentage (>25%, 15-24%, <15%), and CDC immune suppression categories (immune suppression: none, moderate, severe). With primary dentition caries, comparisons were made among all children (2-9 yr-olds, N=73), <2 yr-olds (N=28), 2 to 4 yr-olds (N=20), and 5 to 9 yr-olds (N=25), and compared with NHANES III data. Caries-free status was also determined.

Results: During the 30-month period, there was an almost two-fold increase in primary tooth surface caries for the 2 to 9 year-olds. Caries-free status in the primary dentition declined from 60% at baseline to 37% at the 30-month period. With 5 to 11 years-olds, DMFS and DMFT remained relatively stable, while the proportion of caries-free individuals declined from 72% at baseline to 50% at 18 months. Caries in the primary dentition was increased substantially for those in the low CDC CD4 percentage categories and CDC moderate to severe immune suppression categories.

Conclusion: Primary dentition caries status in HIV-infected children is considerably greater than that for the US pediatric population, and increases with decreasing CD4 percentage and moderate to severe immune suppression. HIV-infected children with caries-free primary dentitions are less frequent than in the US pediatric population, and caries-free status decreases with age, lower CD4 percentage and moderate to severe immune suppression. (*Pediatr Dent* 22:359-364, 2000)

Within the United States, pediatric and adolescent HIV/AIDS accounts for approximately 2% of all cases (Table 1).¹⁻⁶ Vertical transmission with acquisition of HIV transplacentally or during passage through the

birth canal accounts for 84 to 91% of infected infants.^{2,4-6} Blood transfusion and hemophilia are less common risk factors; and with the introduction of HIV p24 antigen blood product screening in the US, this form of HIV transmission is increasingly rare. Although African-Americans make up only about

Table 1. Pediatric HIV Infection and AIDS in the United States*

Exposure Category (<13 years of age)	HIV	AIDS
Vertical Transmission	84%	91%
Blood Transfusion	2%	4%
Hemophilia/Coagulation Disorder	2%	3%
Risk Not Identified	13%	2%
Ethnicity (<13 years of age)		
African-American	63%	58%
Hispanic	11%	23%
White, Not Hispanic	24%	17%
Asian/Pacific Islander	<1%	<1%
American Indian/Alaska Native	<1%	<1%
Persons Living with AIDS		
Pediatric (<13 years of age)	1% (3,669)	
Adolescents (13 - 19 years of age)	1% (3,564)	
Adults	98% (288,994)	
Persons Living with HIV Infection		
Pediatric (<13 years of age)	1% (5,374)	
Adolescents (13 - 19 years of age)	1% (4,472)	
Adults	98% (384,107)	
Persons Dead of AIDS		
Pediatric (<15 years of age)	1% (4,975)	
15 to 24 Years of Age	2% (8,508)	
> 24 Years of Age	97% (406,718)	

* Compiled from reference 1.

15% of the US pediatric population, almost two-thirds of pediatric HIV/AIDS occurs in this ethnic group.¹⁻⁶ Likewise, Hispanic children are over-represented based upon population proportion alone.¹⁻⁶ With an increasing proportion of adolescents and women becoming infected in the US due to sexual contact and intravenous drug transmission, concern exists regarding a possible increase in the absolute number of infants born to women with HIV/AIDS, despite the overall decreased HIV transmission risk with prenatal and perinatal administration of antiretroviral drugs.

Although there are many studies⁴⁻¹⁰ evaluating oral soft tissue manifestations of HIV/AIDS in children, there are relatively few clinical investigations into the prevalence and incidence of dental caries in the primary and permanent dentitions.¹¹⁻¹⁵ Some authorities in pediatric HIV/AIDS have indicated that there is no substantial difference between pediatric HIV/AIDS children and the general child population; while others have noted increased caries susceptibility. In one study of adult Africans, a lower caries prevalence was found in HIV-infected people, than in noninfected persons.⁹ In US HIV-infected adults, caries susceptibility studies have been limited and these have reported conflicting results. The purpose of this longitudinal descriptive study was to determine the dental caries status of children infected with the human immunodeficiency virus (HIV) and compare immune suppression and CD4 percentage with caries status.

Methods

A total of 73 children up to 9 years of age with vertically transmitted HIV-infection were available for evaluation of their primary dentition over a 30 month period. These children were subdivided into three age categories (<2 years of age, N=28; 2 to 4 years of age, N=20; 5 to 9 years of age, N=25). The children were evaluated for caries in their primary dentition (dfs/dft and caries-free) at baseline and at 6 month intervals over a 30 month time period. Comparisons were made between primary dentition caries at each time period and Center for Disease Control (CDC) immune suppression categories (none, moderate and severe) and the CDC CD4 percentage (<15%, 15 to 24%, >25%). The primary dentition caries data were also contrasted with that from the NHANES III national survey of primary dentition caries in United States (US) children from 2 to 9 years of age.¹⁶⁻¹⁸ In addition, 19 children between the ages of 5 to 11 years of age were evaluated for caries in their permanent teeth (DMFS/DMFT and caries-free) at baseline and every 6 months over a 24 month time period. Permanent dentition caries data were compared with that from the NHANES III national survey of permanent dental caries prevalence in US children from 5 to 11 years of age.^{16,17,19} The data from the present study provides trends and not statistical evaluation due to the limited number of children in each variable group. Also, the data is compared with the general US pediatric population, because a large primary caries prevalence study of predominantly US minority children is not available. Human subject approval was obtained from the Institutional Review Board, and informed consent was obtained from the parent(s) or legal guardian prior to inclusion in the study.

Results

During the 30 month time course of this longitudinal study, there was an almost two-fold increase in primary tooth surface caries (dfs, Table 2) from the baseline examination to the 30 month examination for 2 to 9 year-olds. The number of primary teeth involved remained relatively constant for all children between 2 to 9 years of age. Caries-free status in the primary dentition for 2 to 9 year-olds declined from approximately 60% at baseline to 37% at the 30 month examination. For both dfs and dft, the higher levels were typically seen in the 5 to 9 year-olds. Likewise, the lowest proportion of children with a

Table 2. Dental Caries in HIV-Infected Children: Primary Dentition

Age Group	dfs	dft	Caries-Free
NHANES III National Survey of Primary Tooth Caries in US Children*			
2-9 year-olds	3.1	1.4	62%
2-4 year-olds	1.2	0.6	83%
5-9 year-olds	4.1	1.9	50%
Baylor College of Medicine/Texas Children's Hospital Oral Manifestations of HIV Study			
Baseline Examination			
2-9 year-olds	7.0	3.7	57%
<2 year-olds	0.9	NA	87%
2-4 year-olds	2.7	3.0	65%
5-9 year-olds	14.4	4.5	32%
6 Month Examination			
2-9 year-olds	7.6	2.5	60%
<2 year-olds	0	0	100%
2-4 year-olds	7.6	1.5	61%
5-9 year-olds	13.3	4.0	31%
12 Month Examination			
2-9 year-olds	9.6	3.4	47%
<2 year-olds	0	0	100%
2-4 year-olds	8.2	2.6	50%
5-9 year-olds	14.3	4.5	25%
18 Month Examination			
2-9 year-olds	13.8	3.9	39%
2-4 year-olds	9.3	2.6	56%
5-9 year-olds	18.8	5.2	17%
24 Month Examination			
2-9 year-olds	12.0	3.4	41%
2-4 year-olds	10.6	3.0	52%
5-9 year-olds	10.5	3.3	17%
30 Month Examination			
2-9 year-olds	12.8	3.8	37%
2-4 year-olds	16.2	4.1	44%
5-9 year-olds	9.7	3.5	30%

*Compiled from reference 16.

Table 3. Dental Caries in HIV-Infected 5-11 Year-Old Children: Permanent Dentition

	DMFS	DMFT	Caries-Free
Baylor College of Medicine/Texas Children's Hospital Oral Manifestation of HIV Study			
Baseline Examination	1.5	0.8	72%
6 Month Examination	1.2	0.8	68%
12 Month Examination	1.5	1.0	61%
18 Month Examination	1.9	1.3	50%
24 Month Examination	1.3	0.9	64%
NHANES III National Survey of Permanent Tooth Caries: 5-11 Year-Old US Children*			
	0.9	0.6	74%
HIV-Positive Children and Their Siblings (New Jersey Dental School)**			
	dft	DMFT	Caries-Free
HIV-Positive Children			
All Children	3.8	1.0	34%
3-6 Year-Olds	3.2	0	46%
>6 Year-Olds	5.7	1.3	7%
HIV-Negative Siblings			
All Children	1.5	1.0	56%
3-6 Year-Olds	2.0	1.0	58%
>6 Year-Olds	1.7	1.6	33%

* Compiled from reference 16; ** Compiled from references 11 and 12.

caries-free primary dentition were consistently in the 5 to 9 year-old age group. Children in the 2 to 4 year-old age group showed a progressive dfs increase from baseline to the 30 month examination.

With the permanent dentition in 5 to 11 year-olds (Table 3), the DMFS and DMFT were relatively stable. The DMFS ranged from 1.2 to 1.9 over the 24 month period, while the DMFT varied from 0.8 to 1.3 during this same time period. Caries-free status decreased moderately from the initial examination.

For each examination period, the number of carious surfaces and teeth in the primary dentition were highest for those in the CDC severe immune suppression category and least for those without immune suppression according to the CDC guidelines (Table 4). The difference in dfs between no immune suppression and severe immune suppression category ranged from an increase of 6.7 carious surfaces at the 6 month examination to 15.9 carious surfaces at the 30 month examination. The difference in number of carious primary teeth (dft) ranged from 3 to 4 teeth between the no immune suppression and severe immune suppression groups. Substantial differences in dfs and dft were also found between the moderate immune suppression and severe immune suppression groups over the 30 month period. Caries-free status in the primary dentition from the 6 month through the 30 month period was decreased with

both the moderate and severe immune suppression groups when compared with the no immune suppression group.

CD4 percentage categories had certain trends with respect to the number of carious surfaces and teeth in the primary dentition (Table 5). With the lowest CD4 percentage group (<15%), the highest dfs were found in all examination periods. With children having CD4 percentages between 15 to 24%, their dfs scores were intermediate between the lowest CD4 and highest CD4 percentage groups for most examination periods. The difference in the number of primary surfaces involved by caries ranged from as low as 4.6 to as high as 18.8 between the highest (>25%) and lowest (<15%) CD4 percentage categories. The number of carious primary teeth (dft) was highest for those in the <15% CD4 category, most at examinations, and was lowest for the >25% CD4 category, except at baseline and the 30 month examination. Caries-free status in the primary dentition was quite variable among the CD4 percentage categories. In general, there was a trend toward higher caries-free percentages in the highest (>25%) CD4 category.

Discussion

Although HIV-infected children and adolescents have significant oral soft tissue manifestations,⁴⁻¹⁰ it is quite obvious from the findings in the present study and prior studies^{11,12} that dental caries, particularly in the primary dentition, occurs out of proportion to that in the general US pediatric population, as well as in uninfected siblings.^{11,12} Comparison of the data from the present study with the NHANES III survey¹⁶⁻¹⁹ readily illustrates the discrepancy between 2 to 9 year-old HIV-infected children and US preschool and primary school children. With HIV infection, the number of primary tooth surfaces involved by caries is increased by 2.3 to 4.5 fold; while the number of primary teeth affected by caries is 1.8 to 2.8 times greater. Primary dentition caries is increased by even a greater degree in 5 to 9 year-olds with HIV infection, compared with 5 to 9 year-olds in the general US pediatric population. At the baseline examination, the proportion of 2 to 9 year-old HIV-infected children who were caries-free was similar to the NHANES cohort. Over the 30 month period, there was a considerable decrease in the percentage of caries-free HIV-infected 2 to 9 year-olds, with only 37% remaining caries-free compared with a caries-free level of 62% in US 2 to 9 year-olds. While there were a limited number of 5 to 11 year-old HIV-infected children in the present study, caries experience in the permanent dentition was increased over that for 5 to 11 year-olds in the NHANES III survey. DMFS was increased by 1.2 to 2.1 fold and DMFT was increased by 1.3 to 2.2 fold during the 24 month examination period. Caries-free status was similar, but somewhat less than that for the NHANES III 5 to 11 year-olds. Similar trends for primary and permanent dentition caries have been reported in other HIV-infected children in the United States.^{11,12}

Trends toward greater dental caries experience in the primary dentition with increasing immune suppression and decreased CD4 percentages were noted. Severe immune suppression as defined by the CDC categories resulted in consistently high caries prevalence. This category was associated with 2.8 to 23.7 fold increase in dfs compared with

Table 4. Primary Dentition Caries in HIV-Infected Children: Immune Suppression

CDC Immune Suppression Category	dfs	dft	Caries-Free
Baylor College of Medicine/Texas Children's Hospital Oral Manifestation of HIV Study			
Baseline Examination			
None	1.9	NA	57%
Moderate	4.4	3.2	64%
Severe	10.4	4.1	52%
6 Month Examination			
None	3.8	NA	75%
Moderate	4.2	2.7	60%
Severe	10.5	2.7	57%
12 Month Examination			
None	4.3	1.0	67%
Moderate	5.2	2.6	43%
Severe	12.4	4.0	45%
18 Month Examination			
None	3.3	1.0	50%
Moderate	6.8	2.6	45%
Severe	18.3	5.0	35%
24 Month Examination			
None	3.3	1.0	50%
Moderate	6.8	2.6	43%
Severe	18.3	5.0	39%
30 Month Examination			
None	0.7	0.7	67%
Moderate	10.5	3.5	25%
Severe	16.6	4.7	33%

HIV-infected children with no immune suppression. Comparison between moderate and severe immune suppression revealed a 1.6 to 2.7 fold increase in dfs for the severe immune suppression category. The dft at most examination periods was typically 4 times greater for the severe immune suppression group compared with the no immune suppression group. Moderate immune suppression was associated consistently with a lower dft than that for the severe immune suppression category. Both >25% CD4 and 15 to 24% CD4 percentage categories had reduced primary dentition caries experience compared with the <15% CD4 percentage group. The least caries experience was with the >25% CD4 count group and this compared more favorably with that for 2 to 9 year-olds in the NHANES III survey.¹⁶⁻¹⁹ With the <15% CD4 category, dfs was increased by 1.9 to 4.7 fold over that for the >25% CD4 group and 1.5 to 7.9 fold for the 15 to 24% CD4 category. With dft comparisons, the <15% CD4 group had a dft which was typically increased by 2 to 3-fold over the >25% CD4 group and by 1.5 fold over the 15 to 24% CD4 category.

The trend toward increased caries susceptibility in HIV-infected children may be due to several different factors. Many of the children experience failure to thrive and more frequent feedings with carbohydrate and sucrose-rich foods may be necessary to maintain body weight.^{4-6,11,12} It has been shown that increased frequency of carbohydrate intake in HIV infection is associated with increased caries prevalence and cariogenic microbes.^{11,13} In addition to the increased frequency of carbohydrates, many of the medications essential for antiretroviral therapy and prophylaxis against opportunistic infections contain relatively high sweetener levels.^{4-6,11-13} The fact that these medications need to be taken on a frequent basis increases the child's exposure to cariogenic substances.

Immune compromise in HIV-infected children may also be reflected in increased levels of cariogenic bacteria in these children.¹¹ With HIV-infected children, over 40% had very high levels (10⁶ CFU/ml) of *mutans streptococci* in their saliva. In contrast, only 13% of noninfected children had such levels of *mutans streptococci* in their saliva. In HIV-infected children over 6 years of age, high levels of mutans streptococci were found in slightly less than 60%. High *lactobacillus* concentrations in saliva (>10⁵ CFU/ml) have been identified in over 50% of HIV-infected children and in 70% of these children over 6 years of age. In contrast, only about 25% of age-matched HIV-negative children have high levels of *lactobacillus* in their saliva. These findings may, in part, explain the caries differences among the immune suppression and CD4 percentage categories in the present study. With immune suppression and a decreased CD4 percentage, cariogenic bacteria may be increased in the saliva and, likewise, the dental plaque. It has been shown that *lactobacillus* levels, *mutans streptococcus* levels, carbohydrate intake frequency and dft, correlate statistically with the number of years that the child has been afflicted with HIV infection.

Not only is caries prevalence at the time of examination a measure of caries susceptibility, but also the presence or absence of incipient white spot lesions.¹¹ White spot lesions have been reported in two-thirds of HIV-infected children, in contrast to less than 50% of age-matched nonHIV-infected children. Even more remarkable is the fact that the mean number of white spot lesions in HIV-infected children was increased by 22-fold over that for nonHIV-infected children. Gingival status and immune status as determined by CD4 percentage or ratio and CDC immune suppression category also are associated with caries experience.^{13,20} Children with lower CD4 percentages or ratios and immune suppression categories have significantly higher DMFT/dmf and modified gingival and plaque indices.^{13,20}

The oral health of HIV-infected children and a reduction in the caries experience are quite important. It is apparent from this and previous studies¹³⁻¹⁹ that caries in the primary and permanent dentition are considerably increased over the US pediatric population. Recently, the effect of severe caries on the quality of life in children has been examined.²¹ Tooth-associated pain, difficulty with nutrition, hampered growth as noted by body height and weight, and sleep patterns are adversely altered by severe dental caries in children. It is well known that children infected with HIV have growth retardation and failure to thrive. This may be further complicated by the presence

Table 5. Primary Dentition Caries in HIV-Infected Children: CD4 Percentage

CD4 Percentage Category	dfs	dft	Caries-Free
Baylor College of Medicine/Texas Children's Hospital Oral Manifestation of HIV Study			
Baseline Examination			
<15%	9.5	3.6	52%
15-24%	6.4	3.5	71%
>25%	4.9	3.8	54%
6 Month Examination			
<15%	11.1	3.1	58%
15-24%	7.2	3.6	53%
>25%	4.3	2.0	65%
12 Month Examination			
<15%	14.7	4.5	41%
15-24%	7.8	3.0	58%
>25%	5.1	2.2	45%
18 Month Examination			
<15%	22.2	6.0	38%
15-24%	17.1	4.3	27%
>25%	5.3	2.1	50%
24 Month Examination			
<15%	19.5	4.7	42%
15-24%	15.3	6.0	0%
>25%	6.3	2.1	50%
30 Month Examination			
<15%	23.9	6.1	37%
15-24%	3.0	2.0	0%
>25%	5.1	2.1	44%

of severe dental caries in the primary dentition. In pediatric HIV patients, many factors play a role in caries development and attention should be directed toward establishment of a caries prevention regimen prior to the eruption of the primary teeth.

Conclusions

Certain trends were recognized in this descriptive longitudinal study:

1. Primary dentition caries in HIV-infected children is considerably greater than in the US pediatric population (NHANES III).
2. Primary dentition caries in HIV-infected children increases with decreasing CD4 percentage and moderate to severe immune suppression (CDC) categories.
3. Caries-free primary dentitions in HIV-infected children are less frequent than in the US pediatric population (NHANES III), and caries-free primary dentition status decreases with age, lower CD4 percentage, and moderate to severe immune suppression (CDC) categories.

Presented at the Research Section of the American Academy of Pediatric Dentistry Annual Session, Toronto Canada, May 1999. Supported by a grant from NIH-NIDCR (1-RO1-DE11363)

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ABSTRACT OF THE SCIENTIFIC LITERATURE



PULP CAPPING OF CARIOUS EXPOSURES

The purpose of this retrospective study was to determine the long term (5 and 10 years) treatment outcomes of pulp capped teeth. 97 patients that had direct pulp capping done following carious exposures were divided into two study groups, 5 years and 10 years post treatment. All pulp capping treatment was performed by dental students using a setting calcium hydroxide paste. Pulp capping was considered a failure if the tooth was extracted, required root canal treatment or if apical rarefaction was noted radiographically. Results for the 5-year group showed a 37% success rate and a 13% success rate for the 10-year group. The authors found that success was not related to patient's age at time of treatment, site of pulp exposure or location of tooth in arch, but may have been related to the time of placement of the permanent restoration. The authors concluded that direct pulp capping may be useful in maintaining tooth vitality but not for a prolonged period of time and that a definitive restoration should be placed within 48 hours to maximize success.

Comments: Although this study examined a procedure important to pediatric dentist, the conclusions must be considered with caution. The fact that the treatment was completed by multiple dental students and the small sample size make it difficult to generalize these results. **MM**

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Pulp Capping of Carious Exposures: Treatment Outcome after 5 and 10 Years: A Retrospective Study. Barthel, C.R.; Rosenkranz, B.; Levenberg, A.; and Roulet, J.F.: *J Endo* 26: 525-528, September, 2000.

18 references

ABSTRACT OF THE SCIENTIFIC LITERATURE



CHLORHEXIDINE VARNISH TO REDUCE S-MUTANS

The purpose of this prospective study was to evaluate the use of a chlorhexidine varnish to suppress the interproximal caries incidence in children identified as high caries risk. The experimental group consisted of 107 children, (age 8-10), and the control had 63 children all with high counts of S-Mutans living in a community with no fluoride in the water. The chlorhexidine varnish, (Cervitec) was applied to the mesial surfaces of the first permanent molars, 3 times over a two week period, then followed for two years. There was no difference in the overall caries rate of the two groups after two years but the suppression of the S-Mutans in interproximal plaque may prevent and arrest approximal caries.

Comments: The chair time and cost for a specific protective role of a chlorhexidine varnish (Cervitec) on interproximal caries need further evaluation. **LHS**

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Interdental caries incidence and progression in relation to mutans streptococci suppression after chlorhexidine-thymol varnish treatments in schoolchildren. Twetman, S., and Petersson, L. *Acta Odontol Scand* 57(3):144-48, 1999.

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