Association of Dental Health Parameters With Oral Lesion Prevalence in Human Immunodeficiency Virus-Infected Romanian Children

Jung-Wei Chen, DDS, MS Catherine M. Flaitz, DDS, MS Blake Wullbrandt, DDS John Sexton, DDS

Dr. Chen is clinical assistant professor, Department of Pediatric Dentistry, and Dr. Flaitz is interim dean and professor, The University of Texas Dental Branch, Houston, Tex; Dr. Wullbrandt is in private practice, Keene, NH; Dr. Sexton is in private practice, Lakewood, Colo. Correspond with Dr. Chen at jwchen27@hotmail.com

Abstract

Purpose: This study assessed the association of caries, plaque accumulation, gingival health, and antiretroviral therapy (AT) with oral lesion prevalence in human immunodeficiency virus (HIV)-infected Romanian children.

Methods: A convenience sample of HIV-infected children who received dental care in 2 hospitals were evaluated for oral lesions, caries (dfs+DFS/total teeth present), plaque (PI, Silness and Löe), and gingival indices (GI, Löe and Silness). Oral lesions were grouped as: (1) extraoral herpetic infections; (2) parotid gland swelling; (3) oral ulcerative lesions; and (4) fungal infections. A standardized operator performed the examinations and photographed the oral lesions for confirmation. Age, gender, and use of AT were documented. Data were analyzed by logistic and multiple regression, Pearson correlation and *t* test ($P<.05$).

Results: One hundred four children (mean age=11.7 years) were evaluated. Fungal infections were associated with increased caries rate ($P=.002$; OR=2.5) and increased GI ($P=.01$; OR=7.6). Caries, PI, and GI were associated with an increase in oral lesions ($r=0.472$, $P<.001$). AT use was associated with decreased caries ($P=.001$, *t* test), but was not associated with decreased oral lesion prevalence.

Conclusions: Oral lesions, especially candidiasis, are more common in HIV-infected children with higher caries experience, gingival inflammation, and plaque accumulation. In children with limited access to medical care, the role of oral health appears to be important for decreasing the risk of common opportunistic infections. (*Pediatr Dent*. 2003;25:479-484)

KEYWORDS: CHILDREN, HUMAN IMMUNODEFICIENCY VIRUS, ANTIRETROVIRAL THERAPY, MOUTH DISEASES, DENTAL CARIES, GINGIVITIS

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It has been more than 20 years since the first cases of acquired immunodeficiency syndrome (AIDS) were reported, but the toll on human life and global economics makes it one of the most devastating diseases to affect the world.[1] At the end of 2001, an estimated 40 million people were living with human immunodeficiency virus (HIV), with the highest numbers of new infections occurring in adolescents and young adults from developing countries. The number of children under the age of 15 living with HIV is close to 3 million, with 800,000 new infections reported in 2001. These numbers are in stark contrast to the number of children infected in the United States. Latest available figures in the United States estimate that the cumulative total of pediatric HIV/AIDS cases reported in 2001 was only 718.[2] Although these numbers are small in comparison, there is evidence that HIV infection rates among adults are rising in North America, which may affect the pediatric population.

Of significance to the pediatric dentist, children with HIV infection have considerably higher rates of oral diseases, including soft tissue lesions, salivary gland dysfunction, and dental caries, when compared to the general pediatric population.[3] Although there are numerous descriptive studies from both high-income and developing countries documenting the prevalence of the oral manifestations of HIV, the relationship between dental and gingival status and common oral and perioral diseases has not been investigated in children from developing countries. In addition, since

Table 1. The Prevalence of HIV-Associated Oral Lesions in Children and Antiretroviral (AT) Medication Use

	AT drugs (N=56)	No drugs (N=48)	Overall (N=104)
Oral candidiasis	41%	50%	44%
Type not specified	0%	4%	1%
Pseudomembranous	9%	10%	9%
Erythematous	21%	13%	18%
Both types	11%	23%	15%
Angular cheilitis	20%	23%	21%
Linear gingival erythema	27%	31%	28%
Herpes labialis	14%	8%	12%
Parotid enlargement	5%	8%	6%
Facial molluscum contagiosum	13%	35%	20%
NUG/NUP*	5%	10%	7%
Oral ulcers	5%	6%	6%
Herpes zoster scar	4%	2%	3%
Oral hairy leukoplakia	4%	6%	5%
Children with ≥1 lesion	64%	71%	68%

*Necrotizing ulcerative gingivitis/periodontitis.

HIV-infected children in the United States usually have access to a higher level of medical care, including highly active antiretroviral therapy, the findings from this group may not reflect those who are impoverished. On the other hand, the HIV-infected children of Romania represent a sizable number of orphaned or disadvantaged children, many of whom have had limited access to comprehensive medical or dental care.[4] A previous study evaluating the oral manifestations of HIV infection in this group of children demonstrates a high orodental disease rate that is descriptive in design.[5]

The purpose of this study was to assess the association of dental caries, plaque accumulation, and gingival health with oral lesion prevalence in a group of HIV-infected Romanian children. In addition, the role of antiretroviral medications on these oral parameters was evaluated.

Methods

A convenience sample of ambulatory HIV-infected children who received consecutive dental treatment in either of 2 municipal hospitals of Constanta and Iasi, Romania, were included in this study. These children were treated by a volunteer dental team during a 2-week period in June 2000. A comprehensive oral examination, excluding radiographs, was completed by a pediatric dental resident, with assistance from 1 pediatric dentist and 2 general dentists. All examinations were performed using portable dental chairs, artificial light, and dental explorers. Demographic data obtained included gender, age, and antiretroviral therapy (AT) use. All oral and perioral lesions, dental caries rate (dfs, DFS, dft, DFT),[6] plaque accumulation (Silness and Löe),[7] and gingival health (Löe and Silness)[8] were recorded onto individual forms. A dental caries rate was also obtained by calibrated examiners, using the World Health Organization method of assessing dental caries, which was modified to obtain an overall caries rate for both primary and permanent teeth (dfs+DFS/total number of teeth present).[6]

Oral and perioral lesions were diagnosed using the classification and diagnostic criteria as described by the Collaborative Workgroup on the Oral Manifestations of Pediatric HIV Infections.[9] All lesions were photographed using an intraoral camera (Yashica Dental Eye III, Kyocera, Japan) and later reviewed for accuracy by an oral and maxillofacial pathologist. For statistical comparison, HIV-associated oral lesions were broadly grouped as:

1. extraoral herpetic infections, including perioral herpes simplex infection and herpes zoster scarring;
2. parotid gland swelling;
3. oral ulcerative lesions, including necrotizing ulcerative gingivitis/periodontitis, aphthous ulcers, herpes simplex ulcers, and necrotizing stomatitis;
4. fungal infections, including angular cheilitis, candidiasis, and linear gingival erythema.

Prior to being seen by the dental team, each child was screened for medical conditions such as neutropenia, thrombocytopenia, active tuberculosis disease, or advanced AIDS with severe wasting disease. These children were excluded from the study, following consultation from the attending pediatrician. Following the examination, each child received comprehensive dental care, including dental prophylaxis, restorations, and extractions. Prior to initiating this clinical study, administrative approval was received from the Committee for the Protection of Human Subjects at The University of Texas Health Science Center at Houston.

Data analysis procedures applied in this study included descriptive statistics, logistic regression, *t* test, multiple regression, Fisher exact test and chi-square, which were performed with the assistance of SPSS 10.0 statistical analysis software (SPSS Inc, Chicago, Ill).[10] A P value of $<.05$ was considered to be statistically significant.

Results

A total of 104 children–56 females and 48 males, with a mean age of 11.7 years and a range of 6 to 15 years–were evaluated at the 2 dental treatment sites in Constanta and Iasi. Fifty-four percent of these children were on AT to manage HIV infection, which consisted of 2 nucleoside reverse transcriptase inhibitors, zidovudine (ZVD), and lamivudine (3TC), for an average treatment period of 2 years. Types and prevalence of oral lesions in the children are summarized in Table 1. Overall, the prevalence of oral lesions was high in this group of children, with 68% exhibiting at least 1 oral or perioral lesion. In general, the percent of children who were not on AT showed a trend toward an increased number of oral and perioral lesions,

Table 2. Caries Status in HIV-Infected Romanian Children and Antiretroviral (AT) Medication Use

	AT drugs	No drugs	Overall
Primary dentition			
dft (mean)	2.8	5.0	3.5
dfs (mean)	9.1	19.1	12.5
Caries free (%)	7	0	5
Permanent dentition			
DFT (mean)	5.3	7.4	6.0
DFS (mean)	13.2	18.1	14.9
Caries free (%)	9	0	6
Both dentitions caries free (%)	6	0	4
Total no. of carious teeth (%)	32	52	39
Mean decayed and filled surfaces per tooth	0.92	1.40	1.1

but this was not significant (P=.091, chi-square). When individual diseases were evaluated, only facial molluscum contagiosum was diagnosed more frequently in children who were not taking AT (P=.005, Fisher exact test).

Rampant dental caries was common in this group of children regardless of the use of AT (Table 2). Overall, less than 4% of the children were caries free, with the mean dft/dfs being 3.5/12.5 and the mean DFT/DFS being 6/14.9 for the entire group of children. There appeared to be a modest medication effect in the caries rate with children who were taking no medications, experiencing significantly more carious surfaces (P=.001; Table 3). In the medicated group, 32% of the total number of teeth were carious; in the nonmedicated group, 52% were carious. In general, the number of carious permanent teeth was greater than the primary teeth (Table 2). The mean decayed and filled surfaces (dfs+DFS/total teeth present) was very high in both groups. In the medicated group, an average of 0.92 surfaces were carious per tooth; in the nonmedicated group, an average of 1.40 surfaces were carious per tooth (Table 2).

Likewise, the mean PI and GI were moderately high for this group of children, 1.57 and 1.18 respectively, with a significant medication effect observed for both of these oral parameters (Table 3). The majority of children in this study experienced moderate gingival inflammation (54%) and moderate plaque accumulation (64%; Table 4). As expected, the authors found that the PI and GI are significantly correlated to each other (Pearson correlation, R=0.755; P=.0001).

A comparison of the relationship between oral and perioral lesions and dental parameters was performed. Logistic regression was used to evaluate the relationship between the presence of 4 groups of oral and perioral lesions and caries rate, PI, GI, and medication use (Table 5). Four logistic regression results were found to be significant, including parotid gland swelling and decreased PI and no AT, fungal infection and increased caries rate, and fungal infection and increased GI (P<.05). Using odds ratio test, for each single point that the GI was increased, there was a 7.6 times likelihood that a fungal infection would be diagnosed (P=.01; OR=7.6). Increased caries experience was independently associated with a 2.5 times likelihood that a fungal infection would be detected (P=.002; OR=2.5). Con-

Table 3. Summary Table of Mean and Independent Sample *t* Test Between Dental Health Parameters and Antiretroviral (AT) Medication Use

	Caries rate	Plaque index	Gingival index
Overall	1.1	1.57	1.18
AT drugs	0.91	1.46	1.11
No drugs	1.40	1.77	1.31
P value	.001*	.004*	.05*

*Significant findings, independent sample *t* test, P<.05.

Table 4. The Gingival Index and Plaque Index Summary Table

	Gingival index*		Plaque index†	
Mean score	N	%	N	%
0	1	1%	1	1%
0.1-1	42	40%	15	14%
1.1-2	57	54%	67	64%
2.1-3	4	4%	21	20%

*0=normal gingival, 1=mild inflammation, 2=moderate inflammation, 3=severe inflammation.
†0=no plaque, 1=a thin film of plaque, 2=moderate accumulation, 3=abundance of plaque.

Table 5. Summary Table of Logistic Regression Analyses between Dental Health Parameters, Antiretroviral Therapy (AT) Use, and Oral Lesions

		Caries rate	Plaque index	Gingival index	AT use
Parotid gland swelling*	OR†	1.921	0.127‡	5.355	3.251‡
	P	0.410	0.022‡	0.071	0.040‡
Herpetic infection	OR	0.458	0.828	0.553	0.599
	P	0.154	0.840	0.543	0.422
Fungal infection*	OR	2.546‡	2.261	7.608‡	0.543
	P	0.002‡	0.256	0.010‡	0.231
Ulcerative lesion	OR	0.990	0.468	2.553	1.002
	P	0.980	0.309	0.228	0.997

*Significant likelihood ratio, P<.001.
†Odds ratio.
‡Significant association, P<.05.

versely, parotid gland swelling was associated with decreased PI in the non-AT group (P=.022; OR=0.127). In other words, for each single point that the PI was decreased, there was a 7.8 times likelihood that salivary gland enlargement would be diagnosed. Ulcerative lesions and extraoral herpetic infections were not independently associated with increased caries rate, PI, or GI. Caries experience, PI, and GI were associated with an increased number of total oral lesions (R=0.472, P<.001, Pearson correlation). AT medication use was associated with decreased caries (P=.001, t test), but was not associated with decreased oral lesion prevalence (P=.215, t test). When the oral and perioral lesions were evaluated, only parotid gland swelling was independently associated with no AT use (P=.04; OR=3.251).

Discussion

The prevalence of oral and perioral diseases was very high in these HIV-positive Romanian children, but the types of lesions observed are consistent with the oral manifestations associated with HIV infecton.[3,5,9,11-14] In addition, the high prevalence rate observed in this group of HIV-infected Romanian children is consistent with the pattern seen in other developing countries for this age group.[15-22] A composite of recent studies from Brazil, Argentina, Honduras, Ethiopia, Thailand, and Nigeria reveal the following oral disease prevalence: (1) oral candidiasis (38%, N=548); (2) angular cheilitis (9%, N=225); (3) parotid enlargement (14%, N=272); (4) herpes labialis (7%, N=319); (5) oral ulcers (6%, N=204); (6) herpes zoster (2%, N=196); (7) labial molluscum contagiosum (9%, N=11); and (8) oral hairy leukoplakia (8%, N=168).

A variety of contributing factors are cited for the increased numbers of oral lesions in developing countries, including lack of early diagnosis and medical care, poor nutritional status, minimal or sporadic access to AT medications, reliance on humanitarian efforts outside of their country, low CD4 lymphocyte counts, and being orphaned or abandoned.[18,23-27] All of these factors were important issues for the Romanian children in this study.

Due to all the factors stated above, high caries rate, GI, and PI are predictable findings when access to medical and dental care are limited. Comparison of dental caries rates in this study with those of non–HIV-infected children in Romania reveals substantial differences between these 2 groups. In1996, Marthaler et al[28] reported a DMFT of 3.4 among healthy Romanian 12-year-olds, compared to the authors' findings in which the HIV-positive children who received AT had a DFT of 5.3, and the no-AT group had a DFT of 7.4. Overall, the caries rate for permanent teeth in the authors' immunocompromised group was almost 2 times higher (DFT=6) than in healthy children from the same country. In the primary dentition, dental caries was also increased considerably in this study as compared to other investigations.[28,29] Peterson and others[32] reported the oral health status among Romanian school children and documented a mean dfs of 0.8 among 12-year-olds. In contrast, the mean dfs in this study was 9.1 and 19.1 for the AT-use group and the no-AT group respectively. The caries profile observed in this study supported the current belief that caries is more prevalent in the pediatric HIV-infected population.[5,11,12,28,30,31,32]

Furthermore, this study showed a significant decrease in the caries rate for those children receiving ART in contrast to the no-AT group. Only 1 adult study has evaluated the effect of medication use in HIV-infected dental patients, which also showed a lower occurrence of dental caries with AT.[33] No explanation can be given for this finding, although it is speculated that these adult patients are more conscientious health consumers. In the authors' study, it was likely that the children receiving AT had better access to medical care, but this was not confirmed. Additional studies that specifically evaluate quantitative and qualitative differences in the saliva of these children may be helpful in explaining the role of AT and decreased caries risk.

Gingivitis has been shown to occur with a high frequency and greater severity in HIV-infected children.[12,13,30,32,34-36] This pattern was also observed in this study, with half of the children in the AT group and two thirds of the children in the non-AT group having gingival scores that were indicative of moderate or severe gingivitis. Although less than expected, the plaque scores were consistent with mild to moderate plaque accumulation, with a mean score of 1.46 for the AT group and 1.77 for the non-AT group. Although this study did show a positive correlation between GI and PI, quantification of plaque required good lighting, which was less than optimal at times when treating these children in an outreach dental facility. The quantity of plaque may also have been underreported.

The relationship between oral fungal infection and the dental health parameters, such as caries rate, GI, and PI, was an interesting and significant finding. The higher caries rate and more severe gingivitis were independently associated with increased risk for a fungal infection. This finding indicated the important relationship between oral health and the most common opportunistic infection, candidiasis. Marcenes et al[37] reported in an adult HIV-positive population a trend where the worse the dental health parameters, the higher the prevalence of oral fungal infection. This finding was similar to the results in the authors' pediatric population. It is interesting to note that fungal forms, consistent with candidal species, have been observed microscopically in deep dental caries of HIV-positive adults.[14] In this study, approximately 80% of the HIV-infected dental patients had fungal forms in the dentinal tubules of extracted teeth. Therefore, it is speculated that deep carious lesions might provide another niche for this opportunistic infection.

In HIV infection, major salivary glands, especially the parotid glands, may become quite prominent and enlarged. Wide variability in the prevalence of salivary gland disease

in children exists in the literature (4%-47%).[3,5,15,16,27,31,34] In the present study, approximately 7% of the children were diagnosed with this condition. Of interest, the swelling of parotid glands showed an independent association with lower plaque scores. Typically, HIV-positive children with parotid enlargement are healthier and have a better prognosis, which may result in better oral hygiene behavior. In contrast and somewhat unexpected, ulcerative lesions and extraoral herpetic lesions were not associated with any of the dental parameters evaluated.

In this group of HIV-infected children, the number of children with at least 1 oral and perioral lesion was very high (68%). This oral lesion prevalence was higher than other studies evaluating HIV-infected children from developing countries (38%-55%).[5,15-22,30] The total number of oral lesions was significantly correlated to GI, PI, and caries rate, which reinforced the fact that dental health could influence the development of oral opportunistic infections in immunocompromised children.

Conclusions

1. This study revealed that HIV-infected children from a developing country, Romania, have an increased risk for oral lesions, especially candidiasis, when there is a higher caries experience, gingival inflammation, and plaque accumulation.
2. In children with limited access to medical care, the role of oral health appears to be important for decreasing the risk of common opportunistic infections.

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