Prevalence of apical periodontitis in people living with HIV in Southern Brazil

Prevalência de periodontite apical em pessoas vivendo com HIV no Sul do Brasil

Camilla dos Santos Tibúrcio-Machado[1]
Carlos Alexandre Souza Bier[2]
Michael Væth[3]
Gabriela Salatino Liedke[2]
Melissa Orlandim Premaor[4]
Lise-Lotte Kirkevang[5]

Resumo

Objetivo: este estudo transversal teve como objetivo descrever a prevalência de periodontite apical (PA) em pessoas vivendo com HIV (PVHIV) acima de 50 anos de idade, e explorar sua associação com características sociodemográficas, médicas e bucais. Métodos: os dados de 59 PVHIV foram coletados e a região periapical de 1018 dentes foi avaliada através de radiografias periapicais (Rx) usando o Índice Periapical (PAI). A presença e qualidade das obturações radiculares e restaurações (restaurações diretas e coroas) também foram avaliadas no Rx; a presença de cárie foi baseada em dados clínicos e radiográficos. Carga Viral (CV) e contagem de linfócitos T CD4 também foram avaliados. Resultados: a prevalência de PA nos indivíduos foi de 71%, e 8% dos dentes apresentaram PA. Renda familiar >5 salários mínimos (OR=0.06, 95% CI=0.005-0.62) e ter pelo menos um dente com obturação endodôntica (OR=14.55, 95% CI=1.45-145.72) foram associados com a prevalência de PA, enquanto que CV e T-CD4 não foram. A presença de cárie, obturação endodôntica e restaurações foram associadas com a presença de PA no dente. Conclusão: PVHIV apresentaram uma alta prevalência de PA, mas fatores intrínsecos relacionados à infecção pelo HIV não foram associados com PA nos sujeitos avaliados. PVHIV se beneficiariam de políticas públicas de saúde para prevenir a PA, uma vez que os resultados indicam que a doença endodôntica na presente subpopulação pode ser relacionada a problemas sociais.

Palavras-chave: AIDS, epidemiologia, fatores socioeconômicos, lesão periapical, periodontite periapical.

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[1]PhD - Graduate Program in Dental Science, Federal University of Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil
[2]PhD - Department of Stomatology/Graduate Program in Dental Science, Federal University of Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil
[3]PhD - Section of Biostatistics, Department of Public Health, Health, Aarhus University, Aarhus, Denmark
[4]PhD - Department of Clinical Medicine, Health Science Center, Federal University of Santa Maria (UFSM), Santa Maria, Rio Grande do Sul, Brazil.
[5]PhD - Oral Radiology, Department of Dentistry, Aarhus University, Aarhus, Denmark

Introduction

Apical periodontitis (AP) is a chronic inflammatory process in the bone tissue surrounding the dental root in response to a root canal infection[1]. Its primary clinical feature is bone resorption, and periapical radiographs are the most common image method to diagnose the lesion. Root canal treatment eliminates or decreases the microbial load at maximum, preventing bone resorption progress and ultimately promoting healing[2]. A recent meta-analysis showed that 52% of the population worldwide has at least one tooth with AP. The prevalence of this lesion is even higher in individuals with chronic diseases (63%)[3]. Although AP is a local process, it can be influenced by chronic illness. A systemic condition can affect microbial infection and inflammation in AP[4]. Individuals with diabetes mellitus (DM) may be more prone to develop AP after a root canal infection or more resistant to AP healing after a root canal treatment[5]. The systemic inflammation of DM may exacerbate the installed local inflammatory process to combat root canal infection[6].

The consequences of other diseases affecting the patient's immune system in AP progression and healing have also been suggested[6]. The human immunodeficiency virus (HIV) unbalances immune system homeostasis and causes chronic inflammation[7]. The development of antiretroviral therapy (ART) allowed infection control and immune system reestablishment[8]. However, some systemic inflammation may occur in people living with HIV (PLHIV) even after suppressing the viral load[9,10]. Latent infection and ART have represented risk factors for several systemic alterations in PLHIV[10]. They develop chronic and non-infectious diseases at an early age[11,12]. PLHIV also present cardiovascular disease, DM, and osteoporosis more frequently than their general population counterparts[12]. Berberi and Noujeim[13] reported that periodontal disease was the second most prevalent oral disease among these individuals, and its severity was inversely associated with CD4 serum levels. Furthermore, PLHIV with low CD4 had a higher need for endodontic treatment than PLHIV with an adequate CD4 count[13].

The life expectancy of PLHIV has increased considerably since introducing ART. Consequently, older people tend to live with the infection, and evidence suggests that PLHIV may age differently. Considering the lack of studies on this specific group of HIV carriers, new research in this area is encouraged. There is only one study investigating AP prevalence in PLHIV. It reported that 46% of the analyzed subjects had at least one tooth with AP[14]. Regarding oral health, and more specifically, endodontic outcomes, the data from PLHIV are scarce, and to the best of our knowledge, no research has focused on older patients. Thus, our study aimed to describe AP prevalence in PLHIV over 50 years old and to explore a possible association between the endodontic outcome and sociodemographic, medical, and oral (clinical and radiographic) characteristics in these subjects.

Material and methods

Sample selection and eligibility criteria

This study was approved by the Ethics Committee of the Federal University of Santa Maria, RS, Brazil (CAAE 54750216.0.0000.5346) and followed resolution 466/12 of the National Commission of Ethics in Research (CONEP, Brazil) and the declaration of Helsinki. The data was collected from September 2016 to April 2018. All participants signed the informed consent.

It was a cross-sectional study nesting a larger investigation on the prevalence of vertebral fractures in people living with HIV (PLHIV)[15]. All subjects registered in the Infectious Diseases Outpatient Clinic or the Hospital Pharmacy of the Santa Maria University Hospital (HUSM) were invited to participate. Of the 486 subjects registered for antiretroviral therapy (ART) at HUSM, 100 agreed to be contacted for our study. These subjects were invited to participate by telephone and should have at least one tooth to be included in the study.

Image acquisition and radiographic analysis

One investigator (C.S.T-M.) acquired all periapical radiographs (Rx) using a CMOS digital sensor (RVG 5100; Carestream Health, Rochester, NY) and an X-ray unit (Timex 70E; Gnatus, São Paulo, Brazil; 70kVp, 7.0mA, and 0.04s exposure time). Original digital radiographs were exported and saved in tagged image file format (TIFF). The images were viewed on a flat-screen monitor in a room with reduced lighting. Third molars were excluded.

The same observer (C.S.T-M.), who was trained and calibrated to assess AP presence using the periapical index (PAI), examined the radiographs[16]. Teeth were scored as PAI= 1 or 2 for “healthy” and PAI= 3, 4, or 5 for “diseased.” A calibration course was performed for the PAI system by scoring 100 radiographic images provided by Dr. Ørstavik. After calibration, the observer obtained a 0.81 weighted Kappa. Regarding the intra-observer agreement, the sample was scored twice in two months, showing a 0.83 Kappa.

The same observer analyzed the radiographs for root fillings, caries, coronal fillings, crowns, and posts. The quality of root canal treatments, coronal fillings, and crowns was assessed based on a previous study with minor adaptations[17]. Root fillings were “adequate” if they showed no voids and terminated 0-2 mm from the radiographic apex, and those assessed as short, long, and/or with voids were “inadequate.” Coronal fillings and crowns were “adequate” if no overhangs or open margins were visible in the mesial, occlusal, and distal surfaces. Caries were categorized as primary when the lesion was visible on at least one of the accessible surfaces and secondary when it was visible on at least one of the accessible surfaces and in contact with a restoration or crown. Caries in enamel were not considered caries lesions. Twenty-eight images not included in the material were used in the

training process for evaluating the variables. Calibration for root filling quality was initiated by scoring 40 radiographs twice, with a one-week interval between the two evaluations. Kappa yielded a value of 0.52 for intra-observer agreement.

Clinical examination

Caries lesions, coronal fillings, and missing teeth were assessed according to the World Health Organization criteria[18] on the same day of radiographic exams. Three trained and calibrated examiners performed the analyses. A dentist experienced in performing the evaluation using theory-based activities conducted the calibration procedure along with a practical session with one patient. Furthermore, the examiners evaluated 20 extracted teeth twice, with a one-week interval, to proceed with the calibration. These procedures were performed before starting the study and after six months. Kappa test values for inter- and intra-observer agreement were >0.79 and >0.85 in the first calibration and >0.84 for both intra- and inter-observer agreement in the second procedure. Third molar data were excluded.

Structured questionnaire

Patients answered a questionnaire to provide information about demographic and socioeconomic characteristics. The collected demographic variables were sex (male/female), age (years), ethnicity (white/non-white), and the city of patient residence (Santa Maria/other). The socioeconomic variables included monthly family income in Brazilian minimum wages (BMW= approximately USD 290 at the time of data collection) (≤5 BMW/ >5 BMW) and educational level according to years of schooling (≤8 years/ 9–11 years/ >11 years).

Medical records

Information on T CD4 cell count and HIV RNA viral load (VL) were collected from the medical records. All Brazilian HIV subjects have their T CD4 and HIV RNA viral load checked at the Brazilian National Network of Lymphocyte Counting Laboratories T CD4 and the National Network of Laboratories for Quantifying HIV Viral Load twice a year. Both measurements follow the high-quality procedures of the Brazilian Health Ministry, and this study used the one closest to the clinical exam.

Data analysis

Results were presented as frequency and prevalence (%) and mean and standard deviation. Caries presence was assessed clinically and radiographically. The teeth were “decayed” when detecting a carious lesion in either of the two assessments (clinical or radiographic). Only the clinical

data was used when the radiographs did not provide the information. Teeth scored with secondary caries in the Rx evaluation and with primary caries in the clinical data were considered as having primary caries.

Analyses were performed at tooth and person levels. For the person-level investigation, the association between independent variables (sociodemographic, medical, radiographic, and radiographic + clinical parameters) and the outcome (prevalence of ≥1 AP) was assessed using logistic regression with correction for clustering by the individuals through the generalized estimating equation (GEE). For the tooth-level analysis, the association between independent variables (radiographic and radiographic + clinical parameters) and the outcome (AP presence) was tested using logistic regression with correction for clustering by the individuals using GEE. Posts were not included in the adjusted model due to their possible collinearity with crowns. Variables with $p < 0.2$ in the crude models were fitted to the adjusted model for both observation units. The statistical significance level was $p < 0.05$. The statistical analysis was performed using STATA software (Version 12, StataCorp, College Station, Texas).

Results

Person-level analysis

Fifty-nine people living with HIV (PLHIV) participated in the study. Forty-one were either edentulous or did not accept the invitation. A detailed analysis of non-responders was impossible due to Brazilian regulations (resolution 466/12 – CONEP), but the main reason for non-attendance was the fear of suffering from prejudice. Table 1 presents the sample's sociodemographic, clinical, radiographic, and medical characteristics. The mean age was 55.8 years (±5.4). Almost 2/3 of individuals were men (63%), half (47%) had only finished primary school, and 87% had a family income of up to five Brazilian minimum wages (BMW). Most patients had an undetectable viral load (VL) (85%), with a few (4%) presenting >500 copies/ml. Sixty percent of the subjects had normal T CD4 levels (>500 cells/μl). Almost 3/4 of individuals (71%) had at least one tooth with AP, and 42% had at least one root-filled tooth.

The crude analyses showed that apical periodontitis (AP) prevalence was significantly associated with root-filled teeth prevalence and decayed teeth frequency ($p < 0.05$). In the adjusted analysis, individuals with a family income of >5 BMW were less likely to have AP than individuals earning ≤5 BMW ($p = 0.02$). Additionally, individuals with at least one root-filled tooth had a stronger association with AP prevalence than individuals with no root fillings ($p = 0.02$) (Table 2). There was no association between AP and T CD4 and VL.

Table 1 – Sociodemographic, clinical, radiographic, and medical characteristics of the sample.

Variables	n (%)	Mean (SD)
Demographic and socioeconomic characteristics		
Age* (years)	-	55.8 (±5.4)
Sex		
Male	37 (63)	-
Female	22 (37)	-
Ethnicity		
White	35 (63)	-
Non-white	21 (37)	-
Wage		
≤5 BMW	48 (87)	-
>5 BMW	7 (13)	-
Educational level		
≤8 years	28 (47)	-
9 – 11 years	20 (34)	-
>11 years	11 (19)	
City		
Santa Maria	47 (80)	-
Others	12 (20)	-
Clinical/radiographic examination		
Number of teeth	-	17.8 (±7.1)
Number of AP	-	1.3 (±1.2)
Prevalence of AP (≥1 tooth)	42 (71)	-
Number of root-filled teeth	-	0.9 (±1.3)
Prevalence of root-filled teeth (≥1 tooth)	25 (42)	-
Number of decayed teeth	-	3.5 (±2.7)
Number of filled teeth	-	5.0 (±4.7)
Medical chart information		
T CD4+ lymphocytes (cells/μ)	-	594.4 (±226.5)
Viral load (copies/ml)	-	173.5 (±874.1)

BMW, Brazilian minimum wages (approximately USD 290 during data collection).
AP, apical periodontitis.
*One included patient was 44 years old.

Table 2 – Crude and adjusted logistic regression models for the association between AP prevalence and sociodemographic, clinical, and radiographic variables at the person-level analysis. Logistic regression with correction for clustering by the individuals. Odds ratio (OR) at a 95% confidence interval (CI). Variables with values in bold in the crude model were included in the final model (p <0.2). Variables with values in bold in the adjusted model were significantly associated with the outcome (p <0.05).

	Crude			Adjusted		
Variable	OR	95% CI	p	OR	95% CI	p
Demographic and socioeconomic characteristics						
Age (years)*	1.03	0.92-1.16	0.58	-	-	-
Sex						
Male	1					
Female	1.18	0.32-4.39	0.8	-	-	-
Ethnicity						
White	1					
Non-white	0.61	0.16-2.34	0.48	-	-	-
Wage						
≤5 BMW	1			1		
>5 BMW	**0.26**	**0.05-1.38**	**0.11**	**0.06**	**0.005-0.62**	**0.02**
Educational level						
≤8 years	1			-		
9 – 11 years	5.88	0.86-40.39	0.07	-	-	-
>11 years	1.05	0.23-4.9	0.95			
City						
Santa Maria	1					
Others	0.88	0.2-3.78	0.86	-	-	-
Clinical/radiographic examination						
Prevalence of root-filled teeth						
Individuals without root-filled teeth	1			1		
Individuals with ≥1 root-filled teeth	**5.61**	**1.31-24.04**	**0.02**	**14.55**	**1.45-145.72**	**0.02**
Frequency of decayed teeth*	**1.33**	**1.02-1.73**	**0.04**	1.28	0.96-1.71	0.1
Frequency of filled teeth*	1.04	0.89-1.21	0.61	-	-	-
Medical chart information						
T CD4+ lymphocytes (cells/µl)*	1.00	0.99-1.00	0.45	-	-	-
Viral load (copies/ml)*	1.00	0.99-1.00	0.23	-	-	-

*Continuous data.

Tooth-level analysis

The analyses included 1018 teeth. AP and root fillings were in 8% and 5% of the teeth, respectively. Table 3 shows the descriptive data regarding the dental characteristics of the sample.

All independent variables were significantly associated with AP in the crude analysis, except for adequate coronal fillings and crowns (Table 4). In the adjusted regression analysis, the presence of inadequate fillings and adequate crowns lost the association with the outcome. Teeth with primary and secondary caries were, respectively, 14 and 3.4 times more likely to present AP than non-decayed teeth.

Table 3 – Descriptive data of the dental clinic and radiographic characteristics in the studied sample (N=1018).

Variable	n	(%)
Number of AP	77	(8)
Number of root-filled teeth		
Adequate	13	(1)
Inadequate	37	(4)
Number of decayed teeth		
Primary caries	147	(14)
Secondary caries	42	(4)
Number of filled teeth		
Adequate	215	(24)
Inadequate	71	(8)
Number of crowns		
Adequate	9	(1)
Inadequate	10	(1)
Number of posts	15	(1)

AP, apical periodontitis.

Table 4 – Crude and adjusted logistic regression models for the association between AP presence and variables at the tooth-level analysis. Logistic regression with correction for clustering by the individuals. Odds ratio (OR) at a 95% confidence interval (CI). Variables with values in bold in the crude model were included in the final model (p <0.2). Variables with values in bold in the adjusted model were significantly associated with the outcome (p <0.05).

Variable	Crude OR	95% CI	p	Adjusted OR	95% CI	p
Decayed teeth						
Without caries	1			1		
Primary caries	**9.9**	**5.0-19.5**	**<0.001**	**14.0**	**6.3-31.0**	**<0.001**
Secondary caries	**6.5**	**2.53-16.5**	**<0.001**	**3.4**	**1.1-10.4**	**0.03**
Filled teeth						
Without filling	1			1		
Adequate	1.5	0.7-3.0	0.3	**2.6**	**1.3-5.4**	**0.009**
Inadequate	**2.8**	**1.4-5.6**	**0.003**	2.0	0.7-6.0	0.208
Root-filled teeth						
Without root filling	1			1		
Adequate	**7.2**	**2.1-25.1**	**0.002**	**7.0**	**1.1-43.6**	**0.04**
Inadequate	**12.4**	**7.1-21.7**	**<0.001**	**4.8**	**1.6-14.1**	**0.005**
Crowns						
Without crowns	1			1		
Adequate	3.8	0.7-20.5	0.1	3.6	0.6-21.4	0.16
Inadequate	**10.7**	**3.4-34.1**	**<0.001**	**10.3**	**1.9-55.6**	**0.007**
Posts						
Without posts	1					
With posts	**8.7**	**3.2-24.0**	**<0.001**	-	-	-

Discussion

Endodontic medicine endorses the bidirectional interaction between endodontic and systemic diseases considering that endodontic infection may contribute to the overall disease burden and affect patients' health and quality of life. In the present study, 71% of people living with HIV (PLHIV) had at least one tooth with apical periodontitis (AP). Although this finding is comparable to other studies on endodontic disease prevalence in Brazilian subpopulations[19,20] and Asian, African, and European populations[21–23], the rate is very high and cannot be neglected. The multivariate analysis showed that AP prevalence was associated with monthly income, as individuals from higher-income families were more likely to have AP than those from lower-income families. That could not be confirmed in other Brazilian samples because they did not include socioeconomic characteristics as explanatory variables[19,20,24,25]. A recent Croatian study also reported that socioeconomic variables are associated with periapical health[26]. Scandinavian studies have failed to demonstrate an association between economic status and AP[27,28], possibly due to the low social inequality experienced by these countries.

It is worth noting that the studied subjects were 50 years or older. A higher AP prevalence is expected in older individuals because root-filling procedures tend to increase with age due to the accumulation of diseased and/or treated teeth, mainly in populations with a low rate of dental extractions[29]. That could be further supported by the lower AP prevalence rate reported in a previous study with younger PLHIV[14].

AP prevalence was not associated with CD4 counts and the viral load (VL), which was also demonstrated by Fontes et al.[14]. A systematic review reported the absence of HIV infection influence on root canal treatment success, even though such a conclusion was based only on three studies with high and moderate risk of bias[30]. In contrast, De Brito et al.[31] found an association between CD4 counts and the need for endodontic treatment in PLHIV. However, that study did not attempt to control for possible confounding factors. The lack of association between AP and CD4 counts and VL might be due to the protective effect of antiretroviral therapy (ART). The immune system recovery might lead to a normal or near-normal response of the periapical bone when reacting to an endodontic infection.

Our study also evaluated the specific dental factors that might have influenced AP prevalence in PLHIV. At least one root-filled tooth was associated with AP prevalence in the person-level analysis, similar to other studies[27,32]. The same occurred in the tooth-level investigation, which associated root fillings with endodontic disease. Teeth with inadequate root fillings were associated with AP. A cross-sectional design cannot determine if an AP related to a root-filled tooth is a progressing or healing lesion or scar tissue. However, the literature broadly accepts using root-filling radiographic quality as a "proxy" measure of root canal treatment quality[33], and adequate root-fillings are more likely to succeed than inadequate ones[34].

Caries frequency was associated with AP prevalence in the tooth-level analysis but not in the person-level one. Carious lesions have represented a risk indicator for AP[35]. Caries prevalence and socioeconomic variables have been associated, mainly in more unequal societies[36]. Considering that dental caries is often a gateway for pulpal infection and AP[37], it would be reasonable to assume that factors related to caries prevalence might also be relevant for AP prevalence in PLHIV.

Coronal fillings and crowns were also included in the logistic regression model. Crowns with overhangs or open margins were associated with AP, while inadequate coronal fillings lost their association in the adjusted analysis. Ray and Trope[38] found that coronal restoration quality was more significant for the periapical status than root-filling quality in root-filled teeth. However, more recent data have shown that the quality of both coronal restoration and root filling is relevant for the endodontic treatment outcome[39].

Among the strengths of our study is the inclusion of individuals with long-term illnesses and aged 50 years or over, a less investigated subgroup of PLHIV. We also applied a full-mouth survey using periapical radiographs (Rx) to ensure high diagnostic quality. All radiographs were evaluated in their original format, as post-processing filters can affect the appearance of structures on digital radiographic images[40]. Additionally, to overcome inherent limitations, such as the overlap of anatomical structures and image distortion[41], the same tooth was evaluated in more than one radiograph whenever available. Periapical health was assessed using the periapical index (PAI), a well-documented tool for epidemiological studies on periapical periodontitis[3]. The high inter- and intra-observer agreement values for PAI assessment documented in the present study demonstrate that the examiner was consistently trained, producing reliable and reproducible results. However, some limitations should be acknowledged. The relatively small sample size reduced the ability of the study to identify factors associated with AP. Moreover, we could not collect CD4 nadir values, which seems a more reliable marker of immunodeficiency severity experienced by HIV-positive subjects in the past[42]. Possible associations between individual drugs and AP prevalence could not be investigated because of limited information about ART regimens and previous ART.

Since the advent of ART, the longer survival of PLHIV increased the prevalence of non-infectious chronic diseases in these subjects. Hence, an effort to reduce comorbidities and improve their quality of life has become crucial. However, PLHIV still have low access to dental and healthcare services[43,44]. The stigma of the disease plus the misinformation about the actual impact of ART may contribute to this lack of dental care. Although our study shows preliminary results, it suggests that PLHIV with high CD4 and suppressed VL might have AP risk factors similar to people living without HIV. These findings may guide future studies to help increase dental care access for PLHIV.

In conclusion, PLHIV older than 50 years showed a high AP prevalence. Family income and root-filled teeth prevalence were associated with AP, whereas intrinsic factors related to HIV infection were not. At the tooth-level analysis, the factors associated with AP are common to those of the general population (caries presence, root filling presence and quality, and coronal restorations).

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Abstract

Objective: This cross-sectional study aimed to describe the prevalence of apical periodontitis (AP) in people living with HIV (PLHIV) over 50 years old and explore its association with sociodemographic, medical, and oral characteristics. Methods: Data from 59 PLHIV were collected, and the periapical area of 1018 teeth was evaluated through periapical radiographs (Rx) using the periapical index (PAI). The presence and quality of root fillings and restorations (coronal fillings and crowns) were assessed with Rx, and caries presence was based on Rx and clinical data. Viral load (VL) and T CD4 counts were also analyzed. Results: AP prevailed in 71% of individuals and 8% of teeth. Family income of >5 Brazilian minimum wages (OR=0.06, 95% CI=0.005-0.62) and having at least one root-filled tooth (OR=14.55, 95% CI=1.45-145.72) were associated with AP prevalence, whereas VL and T CD4 were not. Caries, root filling, and restorations were associated with AP occurrence. Conclusion: PLHIV presented a high AP prevalence, but intrinsic factors related to HIV infection were not associated with AP in the studied subjects. PLHIV would benefit from oral health policies to prevent AP, as the results indicate that the endodontic disease in the present sub-population might be related to social problems.

Keywords: AIDS, epidemiology, socioeconomic factors, periapical lesion, periapical periodontitis.

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Endereço para correspondência:

Camilla dos Santos Tibúrcio Machado, Federal University of Santa Maria, Santa Maria, RS, Brazil.
Avenida Roraima, 1000, 26F, Camobi, Santa Maria, RS, Brazil. Zip Code: 97105-900
E-mail: camilla_tiburcio@hotmail.com

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