Prevalence and Determinants of Chronic periodontitis in HIV positive patients in Nigeria

Kehinde Adesola Umeizudike¹, Patricia Omowunmi Ayanbadejo¹, Kofoworola Olade Savage¹, Alani Sulaimon Akanmu², Solomon Olusegun Nwhator³, Christian Ibezi Emeka⁴

¹Department of Preventive Dentistry, Faculty of Dental Sciences, College of Medicine, University of Lagos, Nigeria
²Department of Hematology & Blood Transfusion, Faculty of Clinical Sciences, College of Medicine, University of Lagos, Nigeria
³University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria
⁴Department of Oral & Maxillofacial Surgery, Lagos University Teaching Hospital, Nigeria

Objective: To determine the prevalence and determinants of chronic periodontitis in HIV positive patients.

Methods: A total of 120 HIV positive patients attending the dedicated HIV outpatient clinic of the Lagos University Teaching Hospital, Nigeria were recruited for the study. Their periodontal status was assessed using the community periodontal index of treatment needs. Their CD4+ cell count was determined using the flow-cytometer method. The risk factors for periodontitis including age, gender, education, smoking, CD4+ cell counts, bleeding on probing (BOP) were determined.

Results: Prevalence of periodontitis was high (63.3%) in the HIV positive patients. In a bivariate analysis, significant associations were observed between severity of periodontitis and age ≥ 35 years (P=0.021), male gender (P=0.005), smoking (P=0.040) and ≥ 3 community periodontal index of treatment needs sextants exhibiting BOP (P=0.004). In a binary logistic regression, independent predictors of periodontitis were ≥ 3 sextants exhibiting BOP (odds ratio 1.738, 95% CI 1.339 to 2.256, P=0.000) and age ≥ 35 years (odds ratio 1.057, 95% CI 1.005 to 1.111, P=0.030). The CD4+ cell counts were not associated with periodontitis in the HIV positive patients (P=0.988).

Conclusions: A high prevalence of periodontitis was found among the HIV positive Nigerian patients in this study. Older age ≥ 35 years and BOP were the determinants of periodontitis. There is therefore a need for close periodontal monitoring of HIV positive Nigerian patients with emphasis on preventive, professional oral prophylaxis.

KEYWORDS
Periodontitis, HIV, Community periodontal index of treatment needs, Bleeding on probing, Sextants, CD4+ count, Nigeria

1. Introduction

The human immunodeficiency virus (HIV) infection has remained a global pandemic with an estimation of 34 million people living with the infection worldwide¹. Unfortunately, sub-Saharan Africa bears the largest burden of the HIV disease with estimated 23.5 million people living with HIV¹. Nigeria is the most populous country in Africa, and it has the second largest population of people living with HIV infection after South–Africa with the estimated 3.4 million affected people². The HIV infection causes a depletion of the CD4+ cells resulting in an impairment of immune responses.
impact of the infection on affected persons could be enormous, causing numerous health challenges, including a variety of opportunistic infections such as chronic periodontitis. There is a reported higher risk of chronic periodontitis in HIV infected patients[3,4]. Although chronic periodontitis is initiated by microbial plaque, it is mainly the host immune and inflammatory response that are responsible for most of the tissue destruction that occurs[5]. The pathogenesis of periodontitis in HIV infection has been ascribed to the increased numbers of plasma cells, mast cells, macrophages and neutrophils which release preformed pro-inflammatory cytokines mediating bone loss[6,7]. Polymorphonuclear neutrophils in peripheral blood of HIV infected individuals are hyper-responsive, a consequence of lymphocyte depletion and subsequent periodontal tissue damage[8]. Pro-inflammatory cytokines including interleukin-18 (IL-18) are also involved in the pathogenesis of HIV disease. In HIV positive patients, it has been demonstrated that gingivitis and periodontitis sites with high gingival crevicular fluid levels of IL-18 are at significantly greater risk for progression of established periodontitis. In addition, patients with HIV infection and periodontal infection have higher levels of IL-2 and IL-18 than HIV positive patients without periodontitis[9].

Chronic periodontitis in HIV positive individuals often progress gradually, with little or no pain, masking its presence until severe tissue destruction has occurred[10]. Various susceptibility factors may all interact to influence the host immune response[5]. Among HIV positive patients, recognized risk factors include older age[10,11], smoking[10,12,13], viral load[10], poor oral hygiene habits[12], specific microbiota such as Prevotella intermedia and Aggregatibacter actinomycetemcomitans[10], and CD4+ cell counts <200/µL[11,14]. Barr et al. reported a higher risk for periodontal attachment loss in HIV infected subjects over 35 years of age with CD4+ lymphocyte counts <200 cells/mm³[11]. This observation of the association of low CD4+ cell counts with chronic periodontitis in literature is equivocal. Other studies have documented lower periodontitis experience in individuals with extreme immunosuppression (CD4 <200 cells/mm³)[15,16] and a negative correlation between clinical attachment loss and CD4+ cell counts <200 cells/mm³[12,14].

The authors are not aware of any study on the prevalence and associated risk factors for chronic periodontitis in HIV positive patients in Nigeria. The aim of this study was therefore to determine the prevalence of chronic periodontitis and the predictors for periodontitis in HIV positive patients attending the HIV outpatient clinic of the Lagos University Teaching Hospital, Nigeria.

2. Materials and methods

2.1. Study population and sample collection

This was a descriptive cross sectional study by design. A total of one hundred and twenty HIV seropositive patients were recruited into the study. The sample size was determined using the formula: n=Z²pq/d², where n=minimum sample size, Z=critical value set at 95% confidence level, p=prevalence of periodontal disease from a previous study, q=1-p, d=precision level set at 0.05. Their HIV serospositive status was confirmed by Western Blot method following voluntary counselling and testing. Only patients 18 years old and above who were not on highly active antiretroviral therapy were included in the study. Exclusion criteria included pregnancy, diabetes, antibiotic therapy and recent periodontal therapy (in the last six months).

All the patients were attending the HIV outpatient clinic of the Lagos University Teaching Hospital.

Verbal informed consent was obtained before clinical periodontal examination. The study protocol was approved by the Health Research and Ethics Committee of the Lagos University Teaching Hospital. A semi-structured interviewer-administered questionnaire was used to obtain socio-demographic data of the patients. The selected periodontal parameters utilized in the study were the community periodontal index of treatment needs (CPITN)[17,18] and the simplified oral hygiene index[19]. The highest CPITN score for each patient was recorded and used to determine the prevalence of chronic periodontitis. A healthy periodontal status was based on CPITN score 0, CPITN score 1 (bleeding), CPITN score 2 ( calculus), CPITN score 3 (shallow pockets 4–5 mm) and CPITN score 4 (deep pockets ≥6mm). Patients with highest CPITN scores 1, 2 were further classified into non–periodontitis group, while those with highest CPITN scores 3, 4 into periodontitis group[19]. The severity of periodontitis was assessed by the mean number of sextants with CPITN scores 3, 4. The number of sextants exhibiting bleeding on probing was further categorized into two groups, <3 sextants and ≥3 sextants.

A single examiner performed the periodontal evaluations following intra-examiner calibration.

Blood samples were taken at the time of periodontal examination to evaluate CD4+ cell count. Blood (4.5 mL) was taken from one of the veins of the antecubital fossae by venepuncturing using the vacutainer system. The blood specimen was then used for assay of the CD4+ cell count by semi-automated technique using PARTEC Cyflowmetry (made by Partec Gmbh Germany) and was recorded as cells/mm³. The record of the CD4+ cell count was retrieved from patients’ hospital records and was used to categorize the patients into those with <200 cells/mm³, 200–499 cells/mm³ and ≥500 cells/mm³[20].

2.2. Statistical analysis

The SPSS software package version 18 was used for statistical analysis. Categorical variables: gender, education and oral hygiene status were reported as frequencies and percentages, while continuous variables: age, mean number of sextants with highest CPITN scores were reported as means±SD. Differences between the factors of exposure [socio-demographic variables, oral hygiene status, CD4+ cell count and the outcome (periodontitis)] were determined in a bivariate analysis (ANOVA or Pearson’s chi square where appropriate). Multivariate logistic regression analysis was then performed using factors that were significantly associated with periodontitis in the bivariate analysis as the independent variables and periodontitis as the dependent variable. A confidence interval of 95% was used, the level of significance was set at P<0.05.

3. Results

A total of 120 HIV positive patients were recruited for this study, consisting of both males and females and 64.2% of the
study population were females (Table 1). The mean age of the HIV positive patients was (35.5±9.8) years (range 19–72 years). There was a statistically significant difference in age according to gender. Females were younger than the males (32.4±8.9) years versus (41.1±8.9) years, \(P<0.001\) respectively.

Table 1
Age and gender distribution of the HIV positive patients.

| Gender | No. of patients (n) | Mean age±SD (in years) | Age range |
|--------|---------------------|-------------------------|-----------|
| Male   | 43 (35.8)           | 41.1±8.9                | 30–72     |
| Female | 77 (64.2)           | 32.4±8.9                | 19–61     |
| Total  | 120 (100.0)         | 35.5±9.8                | 19–72     |

Table 2 shows other socio–demographic characteristics of the studied subjects. Majority (50%, \(n=60\)) of the HIV positive patients had secondary school education as their highest level of education, followed by those with primary education (26.7%, \(n=32\)), then tertiary level of education (20%, \(n=24\)). Slightly over half (55.8%) of the studied subjects were married. Twenty six (21.7%) of the patients gave a history of smoking.

Table 3 captures the oral hygiene status of the HIV positive patients. Slightly more than half (52.5%) had fair oral hygiene while less than a third (30.8%) had good oral hygiene. Table 4 reveals the distribution of the highest CPTN score among the HIV positive patients. The most prevalent score was CPTN score 3 (55%), which was higher among male (67.4%) than female patients (48.1%). None of the HIV male patients had a CPTN score 0. Periodontitis (highest CPTN score 3, 4) was more prevalent (63.3%) than non–periodontitis (highest CPTN score 0, 1, 2) (36.7%) in the studied subjects (Table 5).

Table 3
Distribution of the socio–demographic characteristics of the HIV positive patients.

| Variable                  | No. of patients (n) |
|---------------------------|---------------------|
| Educational level         |                     |
| None                      | 4 (3.3)             |
| Primary                   | 32 (26.7)           |
| Secondary                 | 60 (50.0)           |
| Tertiary                  | 24 (20.0)           |
| Total                     | 120 (100.0)         |
| Marital status            |                     |
| Single                    | 39 (32.5)           |
| Married                   | 67 (55.8)           |
| Divorced/Widowed          | 14 (11.7)           |
| Total                     | 120 (100.0)         |
| Smokers                   |                     |
| Yes                       | 26 (21.7)           |
| No                        | 94 (78.3)           |
| Total                     | 120 (100.0)         |

Table 4
Distribution of the oral hygiene status of the HIV positive patients.

| Oral hygiene status | Frequency n (%) |
|---------------------|-----------------|
| Good                | 37 (30.8)       |
| Fair                | 63 (52.5)       |
| Poor                | 20 (16.7)       |
| Total               | 120 (100.0)     |

Table 5
Distribution of the highest CPTN score of the HIV positive patients.

| Gender | Highest CPTN score |
|--------|--------------------|
|        | 0  | 1  | 2  | 3  | 4  |
| Male   | 0  | 0  | 10 | 23 | 29 | 4  |
| Female | 2  | 2  | 30 | 39 | 37 | 6  |
| Total  | 2  | 2  | 40 | 53 | 66 | 10 |

Table 6
Distribution of the highest CPITN score of the HIV positive patients.

| Gender | Non–periodontitis (CPITN score 0, 1, 2 n (n)) | Periodontitis (CPITN score 3, 4 n (n)) |
|--------|---------------------------------------------|--------------------------------------|
| Male   | 9 (20.9)                                    | 9 (20.9)                             |
| Female | 34 (44.2)                                   | 29 (41.1)                            |
| Total  | 43 (35.8)                                   | 38 (31.2)                            |

Table 7
Association between socio–demographic variables, oral hygiene and CD4+ cell count and periodontal status of the HIV positive patients.

| Variable                  | Non–periodontitis (CPITN score 0, 1, 2; n (%) | Periodontitis (CPITN score 3, n (%) | P value |
|---------------------------|---------------------------------------------|------------------------------------|---------|
| Age (in years)            |                                             |                                    |         |
| < 35                      | 29 (46.8)                                   | 33 (53.2)                          | 0.018   |
| ≥ 35                      | 15 (25.9)                                   | 43 (74.1)                          |         |
| Gender                    |                                             |                                    |         |
| Male                      | 10 (23.3)                                   | 33 (76.7)                          | 0.023   |
| Female                    | 44 (44.2)                                   | 43 (55.8)                          |         |
| Educational level         |                                             |                                    |         |
| None                      | 3 (75.0)                                    | 1 (25.0)                           | 0.306   |
| Primary                   | 23 (38.3)                                   | 37 (61.7)                          |         |
| Secondary                 | 9 (37.5)                                    | 15 (62.5)                          |         |
| Smokers                   |                                             |                                    |         |
| Yes                       | 7 (26.9)                                    | 19 (73.1)                          | 0.350   |
| No                        | 27 (39.4)                                   | 57 (60.6)                          |         |
| Oral hygiene index score  |                                             |                                    |         |
| Good                      | 17 (45.9)                                   | 20 (54.1)                          | 0.152   |
| Fair                      | 23 (36.5)                                   | 40 (63.5)                          |         |
| Poor                      | 4 (20.0)                                    | 16 (80.0)                          |         |
| Bleeding sextants         |                                             |                                    |         |
| < 3                       | 27 (47.4)                                   | 30 (52.6)                          | 0.021   |
| ≥ 3                       | 17 (27.0)                                   | 46 (73.0)                          |         |
| CD4+ cell count (cells/mm\(^3\)) |                                         |                                    |         |
| < 200                     | 19 (35.2)                                   | 35 (64.8)                          | 0.938   |
| ≥ 200–499                 | 20 (38.5)                                   | 32 (61.5)                          |         |
| ≥ 500                     | 5 (35.7)                                    | 9 (64.3)                           |         |

* Statistically significant
The mean number of sextants exhibiting bleeding on probing in patients with periodontitis was (3.04±1.81) and was significantly higher ($P=0.002$) than that of non-periodontitis group (1.93±1.85). The odds of patients with ≥3 sextants exhibiting bleeding on probing of having periodontitis was 1.74 times (95% CI, 1.34–2.36, $P<0.001$) greater than in patients with <3 sextants exhibiting bleeding on probing. Older age ≥35 years was significantly associated with periodontitis ($P=0.036$) in the HIV positive patients.

4. Discussion

The aim of this study was to determine the prevalence of chronic periodontitis and associated risk factors in a group of HIV positive Nigerians. To the authors’ knowledge, this is the first study on the prevalence of chronic periodontitis among HIV positive Nigerian patients, while the periodontal status of HIV positive persons has been reported in other sub-Saharan African countries like South Africa[12,21,22]. The established CPITN was utilized in this study, because of its major advantages of simplicity, speed, minimal invasiveness, reproducibility and international uniformity[18]. Furthermore, to enrich this study, the authors modified the CPITN by taking into consideration the overall number of sextants that demonstrated bleeding on probing among the HIV positive patients in addition to their highest CPITN score. This variable was used as one of the independent variables to determine its predictive role for periodontitis in this study. Previous studies had challenged the assumption that a tooth with score 3 or 4 should also bleed on probing (score 1[23]). The authors therefore explored the relationship between the number of sextants exhibiting bleeding on probing and periodontitis.

To control for patients’ selection bias, the HIV positive patients were recruited from the dedicated HIV outpatient clinic of the Lagos University Teaching Hospital to provide a more representative study population rather than patients presenting to a dental clinic with oral complaints, which could have unduly increased their prevalence of chronic periodontitis. These HIV patients were also highly active antiretroviral therapy-naïve.

In the present study, the selected periodontal parameters of the HIV patients reflected a very high prevalence of periodontal disease (98.3%) which is quite similar to the 97.4% reported in another study on HIV positive patients in India[3]. This is not surprising and could be attributed to the lower educational status of these patients because most (80%) of the HIV patients had attained at secondary education and only 20% had tertiary education. Other possible factors that could have accounted for the high prevalence of periodontal disease in the present study is the high proportion of HIV patients with advanced form (CPITN score 3, 4) with a smaller proportion having the advanced form (CPITN score 2) to be the most prevalent periodontal condition[25,26]. A CPITN score 2 was also reported as the most prevalent score in an HIV...
infected Indian population[27]. The proportion of patients with deep pockets ≥ 6 mm in the present study (8.3%) is similar to the 9.2% recorded in a study among HIV positive patients in India[27] but differs from the 28.4% reported in another population in India[3]. The lower prevalence of chronic periodontitis observed in the present study could be due to the fact that most of the patients in the present study were recently diagnosed with HIV infection and as such may presumably have a measure of comparable immune status to that of the general presumably HIV uninfected population with possible less marked effects of the immune suppression on their periodontal tissues.

The possibility of prior periodontal destruction in these patients before the influence of HIV immune suppression should be considered which calls attention to the need for longitudinal studies in which cause–effect relationships could be explored.

As observed in the present study, the HIV positive patients were predominantly females (69.1%). The higher proportion of females in this study is supported by the National report documenting a disproportionately higher proportion (58.3%) of women and girls among HIV infected persons[2]. The reason may be the higher physiological or biological vulnerability of women to HIV infection. The significantly younger age of HIV female patients in the present study may be related to the risks and vulnerability of young women particularly girls to sexual violence resulting from the inequity in their social, political and economic status in Nigeria[2].

In the present study, HIV positive male patients had a significantly higher prevalence and severity of periodontitis than females, which corroborates a recent Indian study[27]. Male gender has indeed been considered a risk determinant of periodontitis[28,29]. A plausible explanation will attribute this finding to the poorer oral hygiene in the HIV positive males which was actually reported in an earlier study[24]. It should be borne in mind however that its contribution to periodontitis may have been influenced by the significantly older age of the HIV males than the females in the present study. When the level of immune suppression was compared with their highest CPITN score and the severity of periodontitis (mean number of sextants with CPITN score 3, 4), the associations were not statistically significant. In the present study, although, the HIV patients with CD4+ cell counts <200 cells/mm³ had lower mean number of sextants (CPITN score 3, 4) than those with CD4+ cell counts 200–499 and ≥500 cells/mm³, yet these associations were not significant. This finding confirms several previous studies among HIV infected persons[16,21,30,31]. Goncalves et al. observed that a higher proportion (41.7%) of HIV subjects presenting with severe immunosuppression (CD4+ cell counts <200 cells/mm³) had better periodontal health than those with higher CD4+ cell counts[16]. Their finding was however not significantly associated with the selected periodontal parameters. On the contrary, some studies found a significant association between CD4+ cell counts and chronic periodontitis[12,27]. John et al. found significant associations between CD4+ cell counts and probing depth and clinical attachment level[12]. However, the CD4+ cell counts in their study population were not associated with the severity of periodontal disease. Roza et al. also observed a higher percentage of periodontitis (as expressed by CPITN score 3, 4) among HIV infected subjects with CD4+ cell counts <200 μL than those with ≥200 μL[27]. The variance between these studies and the present study may be explained by the influence of existing contributory factors such as smoking, age, gender and sextants exhibiting bleeding on probing to the prevalence and severity of periodontitis. Genetic factors cannot also be ruled out owing to the racial differences in the different study populations.

Furthermore, the severity of immunosuppression was reported to be more associated with atypical periodontitis than with chronic periodontitis in another study[32]. The higher levels of interleukin IL–18 in the gingival crevicular fluid in gingivitis and periodontitis sites of HIV positive patients may be responsible for tissue destruction in HIV associated chronic periodontitis[33].

The risk determinants observed to be significantly associated with the selected periodontal parameters in this study include the age of the HIV infected patients. Older patients >35 years of age were observed to have a significantly higher prevalence and severity of periodontitis. This has been reported in other studies[11,12]. Barr et al. reported a six times risk for periodontal attachment loss in HIV subjects over 35 years[11]. A more recent study also found age to have a significant correlation with clinical indices such as plaque index, gingival index and probing depth[12]. It is possible that age–related degenerative changes in the periodontal tissues could potentially be a risk factor for increased periodontal tissue destruction with some moderate loss of periodontal attachment and alveolar bone loss[33,34]. Aging alone in healthy elderly persons does not lead to a critical loss of periodontal support[34]. It has however been suggested that the increased level of periodontal tissue destruction observed with aging may be the result of cumulative destruction and the exposure to other risk factors rather than a result of increased rates of destruction[29].

In the present study, smoking was significantly associated with the severity of periodontitis (P=0.040). This observation corroborates findings in a US study[10] and recent findings in HIV–infected South Africans[32]. A higher prevalence of chronic periodontitis has also been reported among the general population in Nigeria[35]. The significant association of smoking with selected periodontal parameter in the present study corroborates the fact that smoking is a well–established risk factor for periodontitis[36]. The association between smoking and periodontitis however became insignificant in the logistic regression analysis. This may be due to the smaller number of HIV positive patients that were smokers in the present study as well as the limited data on the pack years of the smokers which was identified as one of the risk factors in an earlier study[10]. The authors intend to address this gap in information on pack years among HIV positive patients in future studies. Bleeding on probing is widely used as a clinical parameter to monitor periodontal disease progression[37], and has been used to assess the level of gingival inflammation[38]. Clinical trials revealed that bleeding on probing when used as a clinical parameter has a low positive predictive value and the test belongs to disease progression assessment rather than risk assessment. Interestingly, the modification of the CPITN by addition of the number of sextants exhibiting bleeding on probing,
independent of the selected periodontal parameters yielded notable findings. Bleeding of $\geq 3$ sextants was significantly associated with the prevalence ($P=0.021$) and severity of periodontitis ($P=0.004$). Furthermore in a logistic regression analysis, only older age $\geq 35$ years (odds ratio 1.057, $P=0.030$) and bleeding sextants $\geq 3$ (odds ratio 1.738, $P=0.000$) remained predictive of the severity of periodontitis ($\geq 2$ CPITN sextants with score 3, 4). Although, the use of bleeding on probing as a risk assessment has been challenged in a previous review and was viewed as been more suitable for disease progression assessment[39], the association of sextants exhibiting bleeding on probing with periodontitis in the present study merits further investigation.

This study has established a high prevalence of chronic periodontitis in HIV positive Nigerian patients. There is also a significant association of age, smoking and sextants exhibiting bleeding on probing with severity of chronic periodontitis. Sextants exhibiting bleeding on probing and age $\geq 35$ years were found to be independent risk factors for periodontitis among the HIV positive patients in this study. The CD4+ cell counts were not associated with periodontitis in this study. The high prevalence of chronic periodontitis observed among the HIV positive patients in the present study underscores the importance of periodontal screening of HIV positive patients and the need for early preventive measures such as dental visits with oral prophylaxis.

Research frontiers

The present research provides finding of the risk determinants and prevalence of chronic periodontitis in Nigeria, which is limited in that area.

Related reports

The selected periodontal parameters utilized in the study were the CPITN (Ainamo et al., 1982; WHO Oral Health Survey, 1997). In addition, CDC in 1992 revised classification system for HIV infection and expanded surveillance case definitions for AIDS among adolescents and adults.

Innovations & breakthroughs

The present study reports the prevalence of chronic periodontitis and its determinant in Nigeria.

Applications

The research work encourage the need for more surveillance on the maintenance of oral health of HIV patients in Nigeria.

Peer review

In this study the authors evaluated the prevalence and determinants of chronic periodontitis in HIV positive patients. And the results shows the prevalence of periodontitis, and their CD4 amongst HIV patients.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

This work was supported by US President’s Emergency Plan for AIDS Relief. Awarded by US department of health and human resources (Health Resources and Services Administration RSA) to The HARVARD School of Public Health PEPFAR/APIN Programme, Phyllis Kanki (PI), Akamnu AS (Co-PI for Lagos University Teaching site), Grant No U51HA025522. 08/21/04 – 02/28/11.

Comments

Background

The human immunodeficiency virus (HIV) infection has remained a global pandemic with an estimated 34 million people living with the infection worldwide. The impact of HIV infection on affected persons could be enormous, causing numerous health challenges, including a variety of opportunistic infections and chronic periodontitis.

References

[1] UNAIDS. UNAIDS report on the global AIDS epidemic 2013. Geneva, Switzerland: UNAIDS; 2013. [Online] Available from: http://www.unaids.org/en/media/unaids/contentassets/documents/epidemiology/2013/gr2013/UNAIDS_Global_Report_2013_en.pdf. [Accessed on 6 January 2014].
[2] Onah NG. Achieving the millennium development goals through combating HIV/AIDS in Nigeria: ethical perspective. Int J Res Arts Sci 2011; 3: 214–227.
[3] Ranganathan K, Magesh KT, Kumarasamy N, Solomon S, Viswanathan R, Johnson NW. Greater severity and extent of periodontal breakdown in 136 South Indian human immunodeficiency virus seropositive patients than in normal controls: a comparative study using community periodontal index of treatment needs. Indian J Dent Res 2007; 18: 55–59.
[4] Stojkovic A, Borcas VV, Plancak D, Lisic M, Srdjak S. Evaluation of periodontal status in HIV infected persons in Croatia. Coll Antropol 2011; 35 suppl 1: 67–71.
[5] Kinane DF. Aetiology and pathogenesis of periodontal disease. Ann R Australas Coll Dent Surg 2000; 15: 42–50.
[6] Myint M, Odden K, Schreurs O, Halstensen TS, Schenck K. The gingival plasma cell infiltrate in HIV–positive patients with periodontitis is disorganized. J Clin Periodontol 1999; 26: 358–365.
[7] Myint M, Steinsvoll S, Yuan ZN, Johne B, Helgeland K, Schenck K. Highly increased numbers of leukocytes in inflamed gingiva...
from patients with HIV infection. AIDS 2002; 16: 235–243.

[8] Ryder MI, Winkler JR, Weinreb RN. Elevated phagocytosis, oxidative burst, and F-actin formation in PMNs from individuals with intra-oral manifestations of HIV infection. J Acquir Immune Defic Syndr 1988; 1: 346–353.

[9] Falaska K, Vecchiet F, Ucciferri C, Vignale F, Conti P, Pizzigallo A, et al. Periodontitis and cytokine patterns in HIV positive patients. Eur J Med Res 2008; 13(4): 163–168.

[10] Alpagot T, Duzgunes N, Wolff LF, Lee A. Risk factors for periodontitis in HIV patients. J Periodontal Res 2004; 39: 149–157.

[11] Barr C, Lopez MR, Rua-Dobles A. Periodontal changes by HIV and chronic periodontitis in HIV-infected subjects. J Periodontol 2000; 71(11): 1351–1356.

[12] John CN, Stephen LX, Africa CW. Is human immunodeficiency virus (HIV) stage an independent risk factor for altering the periodontal status of HIV-positive patients? A South African study. BMC Oral Health 2013; 13: 69.

[13] Fricke U, Geurtsen W, Staufenbiel I, Rahman A. Periodontal status of HIV-infected patients undergoing antiretroviral therapy compared to HIV–therapy naïve patients: a case control study. Eur J Med Res 2012; 17: 2.

[14] Asif K, Neelima K, Kothiwale SV, Patil R. Periodontal disease in HIV-positive individuals and its possible correlation with CD4+ T cell count. Chron Young Scientist 2012; 3: 151–155.

[15] Vastardis SA, Yukna RA, Fidel PL Jr, Leigh JE, Mercante DE. Periodontal disease in HIV-positive individuals: association of periodontal indices with stages of HIV disease. J Periodontal 2003; 74: 1336–1341.

[16] Goncalves LS, Ferreira SM, Silva A Jr, Villoria GE, Costinha LH, Colombo AP. Association of T CD4 lymphocyte levels and chronic periodontitis in HIV-infected Brazilian patients undergoing highly active anti-retroviral therapy: clinical results. J Periodontal 2005; 76: 915–922.

[17] Ainamo J, Barrdes M, Beagrie G, Cutress T, Martin J, Sardow-Inifuri J. Development of the World Health Organization (WHO) community periodontal index of need (CPITN). Int Dent J 1982; 32: 281–291.

[18] World Health Organization. Oral health surveys: basic methods, 4th ed. Geneva: World Health Organization; 1997.

[19] Greene JC, Vermillion JR. The simplified oral hygiene index. J Am Dent Assoc 1964; 68: 7–13.

[20] 1993 revised classification system for HIV infection and expanded surveillance case definition for AIDS among adolescents and adults. MMWR Recomm Rep 1993; 41: 1–19.

[21] Khammisa R, Feller L, Altini M, Fatti P, Lemmer J. A comparison of chronic periodontitis in HIV-seropositive subjects and the general population in Ga–Rankuwa area, South Africa. AIDS Res Treat 2012; doi:10.1155/2012/620962.

[22] Thiri R, Feller L, Blignaut E. The severity, extent and recurrence of necrotizing periodontal disease in relation to HIV in status and CD4+ T cell count. J Int Acad Periodontol 2010; 12(4): 98–103.

[23] Leroy R, Eaton KA, Savage A. Methodological issues in epidemiological studies of periodontitis–how can it be improved? BMC Oral Health 2010; 10: 8.

[24] Umeizudike KA, Ayambadejo PO, Savage KO, Akannu AS. Relationship of oral hygiene status and practices with oral lesions in a group of HIV positive patients in Lagos, Nigeria. Niger Dent J 2012; 20: 31–36.

[25] Okieghemen SA, Jeboda SO, Umweni AA. A preliminary assessment of the periodontal status of elderly pensioners in Benin city, Nigeria. Gerontology 2012; 29: e1244–e1248.

[26] Umoh A, Azodo C. Association between periodontal status, oral hygiene status and tooth wear among adult male population in Benin City, Nigeria. Ann Med Health Sci Res 2013; 3: 149–154.

[27] Rozsa S, Kundu D, Saha B, Rudra A, Chakraborty S, Bharati P. Periodontal status of HIV infected patients with special reference to CD4 cell count in West Bengal, India. Asian Pac J Trop Dis 2012; 2: 470–474.

[28] Alam MD, Mishra P, Chandrasekarana SC. Gender basis of periodontal diseases. Indian J Basic Appl Med Res 2012; 3: 128–135.

[29] Novak KF, Noval MJ. Risk assessment. In: Newman MG, Takei H, Klokkevold PR, Carranza FA, editors. Carranza’s clinical periodontology. 10th ed. Maryland Heights: Saunders Elsevier; 2006, p. 602–608.

[30] Alves M, Mulligan R, Passaro D, Gawell S, Navazesh M, Phelan J, et al. Longitudinal evaluation of loss of attachment in HIV–infected women compared to HIV–uninfected women. J Periodontol 2006; 77: 773–779.

[31] Doshi D, Ramapuram JT, Anup N, Sharma G. Correlation of CD4 cell count with gingival bleeding index in HIV positive individuals. Med Oral Patol Oral Cir Bucal 2008; 13: E348–E351.

[32] Gemmell E, Marshall RI, Seymour GJ. Cytokines and prostaglandins in immune homeostasis and tissue destruction in periodontal disease. Periodontology 2000 1997; 14: 112–143.

[33] Hebling E. Effects of human ageing on periodontal tissues. In: Manakil J, editor. Periodontal diseases—a clinician’s guide. Rijeka: InTech; 2012.

[34] Huttner EA, Machado DC, de Oliveira RB, Antunes AG, Hebling E. Effects of human aging on periodontal tissues. Spec Care Dentist 2009; 29: 149–155.

[35] Nwachukwu SO, Ayambadejo PO, Savage KW, Jeboda SO. Oral hygiene status and periodontal treatment needs of Nigerian male smokers. TAF Prev Med Bull 2010; 9: 107–112.

[36] Genco RJ, Borgnakke WS. Risk factors for periodontal disease. Periodontol 2000 2003; 32: 59–94.

[37] Loe H, Silness J. Periodontal disease in pregnancy: prevalence and severity. Acta Odontol Scand 1963; 21: 533–551.

[38] Barendregt DS. Probing around the teeth[D]. Amsterdam: University of Amsterdam; 2009.

[39] Dannan A. Periodontal risk assessment; are we on the right track? Arch Oral B 2013; 1: 162–167.