Smokers and Non Smokers: A Comparison of Oral Health Practices and Effect of Non Surgical Periodontal Therapy on their Periodontium

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Summary
Aims and objectives: *To assess the oral hygiene measures and self report oral symptoms of smokers and non smokers, as well as evaluate and compare the effect of non-surgical periodontal therapy on their periodontium.*
Materials and methods: *This was a quasi experimental study conducted on smokers and non smokers. Adult patient smokers were recruited into the study group and matched with age and sex controls (non-smokers). Data was collected on oral hygiene measures and self reported oral symptoms. The patients were examined and evaluated using oral indices. Each patient had scaling and root planing done and was re-examined after six weeks. Data was analysed using SPSS.*
Results: *Seventy-two patients completed the study with age ranging from 20 to 65 years and a mean age of 43.7 (± 17.8) years. Twenty-one percent (21%) of smokers and 42% of the non smokers reported experiencing gum bleeding, p = 0.041. Sixty percent of the smokers reported stains on their teeth compared to 29.7% of non smokers, p = 0.028. The baseline gingival and calculus indices were lower in smokers compared to non smokers while the plaque index was higher among the smokers. The response to scaling and root planing was worse among smokers comparing their gingival and calculus indices but better in terms of the plaque indices, however, these were not statistically significant.*
Conclusion: *There were no significant differences between the response of smokers and non smokers to non surgical periodontal therapy although smokers experienced gingival bleeding less often and have lower gingival index.*

Keywords: Smokers; periodontal diseases; scaling and root planing; non-surgical therapy; non-smokers; oral health status

Introduction

Smoking as an important risk factor for periodontal disease is associated with modification of the host response to dental plaque, the primary aetiological factor for the disease.[1] The modification of the host response is such that there is disruption of normal physiologic vasculature, humoral and cellular immune responses, cell signalling processes and tissue haemostasis which leads to reduced blood flow.[2] In addition to increasing the risk of an individual's development of periodontal disease, tobacco smoking can affect the pathogenesis and change the disease pattern in populations.[2-4] This effect of smoking in changing the periodontal disease pattern of the the population is due to the finding of less gingival bleeding

on probing associated with less inflamed marginal tissue and lower bleeding score in this group of people in the population. This change of periodontal disease pattern in this group of people also include deeper probing depth and a larger number of deep pockets; more attachment and alveolar bone loss; more tooth loss and more teeth with furcation involvement[5-7]. Studies have shown that smokers have greater amounts of plaque and calculus deposits compared to non smokers[8,9] while some authors have reported contrasting findings.[10] Poor oral health behaviour has been suggested as possible reasons for the differences in these reports[11]. The features of periodontal disease that have been reported in tobacco smokers include gingivitis, increased periodontal pocket depth, alveolar bone loss, increased gingival recession, attachment loss and tooth mobility.[3,12,13]

The cumulative effect of smoking on the periodontium may not be exclusive of the difference in oral health practices, such as less frequent dental consultation, which is exhibited by smokers when compared to non smokers.[11] It may also be due to differences in self reported oral symptoms such as mouth odour, teeth staining and gum problems in smokers[8]. The response and effect of periodontal therapy in smokers relative to non smokers have generated equivocal reports in the literature; whereas some authors have published reduced response of smokers to therapy when compared to non smokers,[14-17] Zuabi et al.[18] reported no significant difference in response to treatment between the two groups. It is, therefore, important to investigate the role of contributory factors such as oral health behavioural practices of smokers and non smokers on their responses to non-surgical periodontal therapy.

Additionally, in developing countries with high prevalence of periodontal disease,[19,20] tobacco smoking is a hidden lifestyle most especially among women[21] resulting in very limited research into the periodontal health of smokers before and after lifestyle modification. Tobacco smoking, hitherto thought to be relatively uncommon in Nigeria, is increasingly becoming prevalent especially among the youths and reported smoking prevalence have varied from 3.4% in Ibadan to 12.8% of adolescents in Adamawa.[21] Although the majority of Nigerians are aware that tobacco smoking affects oral health, only 20 (2.2%) in a cross-sectional study of 992 adults surveyed in the south-Western part of the country knew that smoking specifically affects the gum.[22] Studies that had previously compared the oral hygiene indices of smokers and non smokers in Nigeria have predominantly involved non-patient populations,[8,9] which may not adequately incorporate "oral health seekers". This is important because oral health care in many developing countries is treatment need driven.

The aims of this study therefore included: assessment of the oral hygiene measures, self report oral symptoms as well as evaluation and comparison of the effect of conventional non-surgical periodontal therapy (scaling and root planing) amongst tobacco smokers and non smokers attending a major dental centre in a developing country.

Materials and methods

Study design

This was a quasi experimental study conducted on smokers and non smokers attending the Periodontology Clinic of the Dental Centre at the University College Hospital, Ibadan, Nigeria. Following ethical approval from the Joint University of Ibadan/University College Hospital, Ibadan, Ethics Review Committee, consenting adult patients were recruited into the study group and control group. The study group was made up of consecutive patients who were actively smoking cigarettes and had no underlying systemic illness attending the Periodontology Clinic of the hospital. The control group consisted of age and sex matched patients attending the Periodontology Clinic who do not smoke and had no underlying systemic illness based on medical history, normal blood pressure readings and normal random blood glucose. Patients with systemic illnesses or who failed the screening tests, past smokers and those who declined consent were excluded. A minimum sample size of 32 patients in each group was estimated ($n = \frac{2[Z_{\alpha}\sqrt{2P_c(1-P_c)} - Z_{\alpha}\sqrt{P_t(1-P_t)+P_c(1-P_c)}]^2}{[P_t - P_c]^2}$) using a significance level of 5% and prevalence of moderate to severe periodontitis in smokers (25.7%) and non smokers (13.1%) obtained from a previous study[1] to achieve a power of 90% for the study.

Data collection

Data was collected on sociodemographic characteristics, oral hygiene and self reported oral symptoms in addition to oral examination. The sociodemographic data collected included age, gender, marital status, occupation and educational qualification. Questions assessing the oral hygiene measures were on tooth cleaning material, frequency of tooth cleaning and prophylaxis in the form of scaling and polishing. The self reported oral symptoms included: bleeding gums, mouth odour, stains, loose teeth and perception of having oral health problems i.e. feeling unwell.

Oral examination

This was done at the clinic by two trained and calibrated examiners using sterile periodontal probes and dental mirrors. Examination was done on a conventional dental chair with its lighting unit serving as source of illumination. Baseline data on periodontal parameters was documented for each patient before scaling and root planing was done. The contact addresses of the patients were obtained and they were called back for review after a week for the routine post treatment assessment. Post treatment data for this study was collected six weeks after treatment in both the study and control groups.

The periodontal parameters assessed were gingival status and plaque and calculus accumulation. The gingival status was assessed using the gingival index of Loe and Silness[24] on six index teeth; 16, 12, 24, 32, 36, 44. A score of 0 indicated normal gingiva, 1 – mild inflammation with slight colour change and slight oedema but no bleeding on probing, 2 – moderate inflammation i.e. redness, oedema and glazing, bleeding on probing and 3 indicated severe inflammation – marked redness and oedema, ulceration with tendency to spontaneous bleeding.

Plaque accumulation was assessed using the plaque index of Silness and Loe[25] and plaque accumulation was assessed on six index teeth; 16, 12, 24, 32, 36 and 44. Scoring was done as follows; 0 indicated no plaque accumulation, 1 – when a thin film of plaque was found adherent to the free gingival margin or adjacent tooth, which was not obvious to the naked eyes except with the use of a probe, 2 – moderate accumulation of soft deposits within the gingival pocket that could be seen with the naked eye or on tooth and gingiva and 3 – abundance of soft matter within gingival pocket, on the tooth and gingival margin.

Calculus accumulation was determined using the calculus index of Greene and Vermilion.[26] Scoring of the calculus accumulation was as follows: 0 – no calculus found, 1 – supragingival calculus covering not more than a third of the exposed tooth surface, 2 – supragingival calculus covering more than a third but not more than two thirds of the exposed tooth surface while 3 represented supragingival calculus covering more than two thirds of the exposed tooth surface. Six index teeth were used for the assessment: 16, 11, 26, 31, 36, and 46.

Inter-examiner variability was calculated for correct and standard measurements where every fourth patient had a duplicate examination until a total of 16 (20%) patients were re-examined. The values of inter-examiner Kappa scores were 0.92 for examination for gingival index and 0.94 for calculus and mobility indices.

Data Management

Data was entered into a computer using SPSS version 17. Data on the oral hygiene measures and self report oral symptoms of the smokers and non smokers were compared using Chi square statistics. The pre and post intervention periodontal parameters of the smokers and non smokers were compared using student t test. Paired sample t test was used to evaluate the intervention in the study participants. The level of statistical significance was set at $p < 0.05$.

Results

A total of 80 patients (40 in each group) were recruited for the study out of which four were lost to follow up in each group and 72 (90.0%) completed the study (those 72 had pre and post intervention oral hygiene indices compared). Their ages ranged from 20 years to 65 years; with a mean age of 43.7 (± 17.8) years. There was no difference in the mean age of participants in the study (44.1 ± 18.1 years) and control (43.4 ± 17.8 years) groups ($p = 0.867$). There were 48 males (24 in each group) and 32 females (16 in each group). Table i shows the sociodemographic details of the patients. The majority (77.5%) of participants in the study group had smoked for between 6 and 15 years and most (82.5%) smoked 1 to 10 sticks of cigarette per day (table ii).

Tooth cleaning material and frequency of cleaning

All but one of the study participants used toothbrushes to clean their teeth. The frequency of brushing was once daily for 19 (47.5%) of the smokers and 26 (65.0%) of the non smokers, and twice daily for 21 (52.5%) smokers and 14 (35.0%) non smokers ($p = 0.115$). A similar number of smokers (5, 12.5%) and non smokers (4, 10.0%) practised inter dental cleaning using dental floss. There was no difference between the two groups on the choice of material used to remove food particles stuck in between the teeth because majority (66.7% of smokers and 55.0% of non smokers) used toothpicks to do this ($p = 0.312$). Only a few of the smokers (27.0%) and non smokers (21.6%) had scaling and polishing done within twelve months prior to the study ($p = 0.588$).

Self reported symptoms

Forty-two percent (42%) of the non smokers reported experiencing occasional gum bleeding compared to 20.5% of the smokers, $p = 0.041$. Gum bleeding was provoked by tooth brushing in 53.8% of the participants. Sixty percent of the smokers reported stains on their teeth compared to 29.7% of the non smokers, $p = 0.028$.

Only 3 (8.6%) of the non smokers reported experiencing loose teeth compared to 8 (23.5%) of the smokers ($p = 0.090$). There was no difference between the proportion that reported mouth odour among smokers (27.0%) and non smokers (16.2%), $p = 0.259$. The mouth odour was perceived by the majority (76.5%) of participants themselves while the spouse of some (11.8%) perceived the odour. There was, equally, no significant difference between the perception of oral health problems by the smokers (33.3%) and non smokers (27.8%), $p = 0.609$.

Evaluation of effectiveness of scaling and root planing

There were significant improvements in the gingival, plaque and calculus indices after scaling and root planing in all the participants (table iii).

Comparison of periodontal parameters between the two groups

The baseline gingival index was higher in non smokers (mean gingival index = 1.19) than in smokers (mean gingival index = 1.13), $p = 0.506$. The mean calculus index before commencement of treatment was higher in the non

smokers (1.56) compared to smokers (1.38), p = 0.210. The baseline plaque index was higher among the smokers (mean plaque index = 1.47) than in the non smokers (mean plaque index = 1.42), p = 0.697.

The response to scaling and root planing was better among non smokers when measured by the mean differences between pre and post intervention gingival indices and calculus indices but better in the smokers in terms of the plaque indices (table iv). These were, however, not statistically significant.

Table i: Sociodemographic characteristics of the study participants

Variable	Smokers	Non smokers	Total	p-value
Sex				
Male	24	24	48	1.000
Female	16	16	32	
Occupation				
Professional	3	7	10	0.356
Civil Servants	9	7	16	
Pensioners	9	4	13	
Traders and Artisans	11	14	25	
Students	8	8	16	
Religion				
Christianity	38	33	71	0.126
Islam	2	7	9	
Marital Status				
Single	16	15	31	0.594
Married	23	24	47	
Widowed	1	1	2	
Tribe				
Yoruba	35	33	68	0.562
Others	5	7	12	

Table ii: Smoking status of the study participants

Duration of smoking (years)	Number (%)
≤ 5	2 (5.0)
6 – 10	15 (37.5)
11 – 15	16 (40.0)
≥ 16	7 (17.5)
Total	**40 (100.0)**
Number of sticks smoked per day	
1 – 5	18 (45.0)
6 – 10	15 (37.5)
11 – 15	7 (17.5)
Total	**40 (100.0)**

Table iii: Comparison of the mean values of the gingival, plaque and calculus indices before and after scaling and root planing amongst all the patients using the paired sample student t-test.

Periodontal parameter	Mean (SD)	Mean difference	t	p value
Gingival index				
Pre intervention	1.16 (0.37)	0.78	22.53	< 0.001
Post intervention	0.38 (0.21)			
Plaque index				
Pre intervention	1.46 (0.51)	0.98	24.39	< 0.001
Post intervention	0.48 (0.28)			
Calculus index				
Pre intervention	1.46 (0.64)	1.03	20.41	< 0.001
Post intervention	0.44 (0.33)			

Table iv: Comparison of the effect of scaling and root planing on smokers and non smokers

Periodontal parameter	Pre intervention	Post intervention	Mean difference	p value
Gingival index				
Smokers	1.13 (0.30)	0.40 (0.21)	0.73	0.597
Non smokers	1.19 (0.42)	0.37 (0.22)	0.82	
Plaque index				
Smokers	1.47 (0.51)	0.48 (0.30)	0.99	0.830
Non smokers	1.42 (0.53)	0.49 (0.28)	0.93	
Calculus index				
Smokers	1.38 (0.62)	0.37 (0.27)	1.01	0.125
Non smokers	1.56 (0.63)	0.49 (0.37)	1.07	

Values are: mean (SD)

Discussion

This study compared the oral health care practices; self report oral symptoms and the response to periodontal therapy amongst smokers and non smokers. From this study, a higher proportion of smokers cleaned their teeth twice daily relative to non smokers which is in contrast to previous reports where non smokers were found to exhibit better oral hygiene behaviour.[27] The present study found that a higher proportion of smokers compared to non smokers, had scaling and polishing done in the past which is at variance with the findings from previous studies where smokers were less likely to consult dentists.[11,28]

Although these results as observed from the present study were not statistically significant, they were suggestive of better oral hygiene behaviour in smokers compared to non smokers.

The self report of oral symptoms in individuals may help in ascertaining their perceived need for oral health care, hence this was used to further buttress how the two groups differ with regards to their oral health behaviour. Noted in this study, similar to previous studies,[29-32] was the significantly lower proportion of smokers reporting gingival bleeding compared to non smokers. This finding that smokers reporting lesser gingival bleeding adds to the existing literature references[3,7,38] which further confirms that non smokers were more likely to report gingival bleeding than the smokers.

Smokers in this study perceived mouth odour more often than non smokers. This is probably due to smoking by smokers as reported by 12% of 902 respondents in a previous study[22] in Nigeria as the way by which smoking affects oral health. Furthermore, a significantly higher proportion of smokers reported staining of their teeth than non smokers, which is in agreement with previous documentations that staining of teeth is one of the consequences of smoking.[33]

The perception that the patients have in relation to the belief that they have oral health problems was found to differ between smokers and non smokers, with the former more likely to concur that they have problems requiring dental care. This is similar to what had been reported by Dye et al.[34] that smokers tend to experience dental disease more frequently and perceived a greater need for dental care than non smokers. An explanation for this self perceived need for oral health care may be a reflection of their level of awareness about the effect of smoking on oral health, which brought them to the dental centre. It could also be attributed to the obvious stains noted on their teeth, which to them constituted an oral health problem and it may be reasoned out as a better oral hygiene behaviour that was displayed by the smokers in this study.

The pre intervention plaque index of the smokers was higher than that of the non smokers, although not statistically significant in the present study; it is in accordance with a previous study[32] which observed that the plaque index in smokers was significantly higher than that of non smokers. Arowojolu et al.[9] in a cross sectional study comparing the oral hygiene status of smokers and non smokers in Ibadan, Nigeria reported more plaque accumulation in smokers. Plaque accumulation in smokers may be as a result of the stains present on their teeth which lead to roughening of the teeth surface and encourage rapid plaque accumulation.[9] However, of note is the reduction in the mean plaque index post intervention in spite of continued smoking which may be ascribed to subsequent good oral hygiene habits of the smokers. On the other hand, the short duration of the study (six weeks) might not have allowed heavy build-up of the stains to gather more plaque as observed before intervention. Conversely, Nwhator and Olagundoye,[8] in a comparison of outcome of dental hygiene prophylaxis between 13 non smokers and 8 smokers in Lagos, Nigeria found that smokers had no significant change in their oral hygiene status after a six months period. It is probable that the six months period allowed more plaque to accumulate because the staining continues compared to the shorter duration of the follow up in our study. It is thus worrisome that oral hygiene behaviour even among "oral health seekers" may not be enough to prevent worsening of the periodontal health of smokers, smoking cessation then becomes a better public health alternative.[9]

Our study revealed that the pre intervention gingival index in smokers is lower than that of non smokers, this and the self report of gingival bleeding in smokers further confirms previous documentation that gingival bleeding is less likely in smokers than non smokers.[32] The vasoconstrictive effect of nicotine on the peripheral vessel of the gingiva may be responsible for limiting the occurrence of bleeding.[2,32] This vasoconstrictive effect is, however, not fully substantiated because it is a transient phenomemnon that at best masks the bleeding.[22] The gingival index was reversed post intervention with smokers having a higher gingival index than non smokers, although this was not statistically significant, the exaggerated response to inflammation, a defective immune response and the delay in wound healing noted in the gingiva of smokers may explain this.[22,33,35] The delay in wound healing has been attributed to defective neutrophil function, impaired fibroblast proliferation and poor immunoglobulin response.[22,33,35]

The calculus index was comparable in both groups – the mean values pre intervention was not significantly different between both groups; this was also the case for the post intervention calculus index. Our study therefore showed that there was no significant difference in the response of smokers and non smokers following scaling and root planing. While our study corroborates the findings of Preber et al.[32] in this regard, it contrasts some other authors' reports that noted significantly better response in non smokers to periodontal treatment.[36,37] The different ways of assessing the effect of response to treatment may be responsible for this reported difference by these authors. A major limitation of the present study is the short period of follow up after non surgical periodontal therapy. A longer period would have allowed for a more comprehensive evaluation of the outcome of treatment, but this would have been challenging because of the non-compliance of patients in our environment with keeping long term appointments.

Conclusion

This study showed that smokers experienced gingival bleeding less often and they had lower gingival index as well as more self report staining of their teeth than non smokers. In this study, no significant difference was found in the response of smokers and non smokers to non surgical periodontal therapy.

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