

Tobacco Smoking and Periodontal Conditions in an Adult Population from Constanta, Romania

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Abstract

Aims: The aim of this study was to evaluate the effects of smoking on periodontal tissues of patients who attended a dental clinic in Constanta, Romania, by assessing the Community Periodontal Index of Treatment Need (CPITN) score, plaque and calculus accumulation in smokers and non-smokers, and testing these variables for correlations with smoking or not smoking. **Methods:** A convenience sample of 528 dentate individuals (age: 18-65 years) who attended the dental clinics at the Dental Faculty of the Ovidius University, Constanta, were invited to take part in the study; of these, 483 formed the cohort for the study. Patients were divided into four age groups: <35 years of age, 35-44 years of age, 45-55 years of age, >55 years of age. A full-mouth clinical examination was performed and patients completed a questionnaire made up of structured written questions. A CPITN score was recorded for each patient. The Plaque Index (PI) and the Calculus Index (CI) were used to assess the level of oral hygiene. The null hypothesis was that there are no significant clinical differences regarding plaque deposits, calculus accumulation, and CPITN scores between smokers and non-smokers. **Results:** The mean age of the study group was 38 years (SD 17.8), with a mean of 43 years (SD 19.4) in the non-smokers group and 32 years (SD 13.3) in the smokers group, indicating that the smokers group included younger subjects than the non-smokers group. Overall, 219 (45%) sample participants reported that they currently smoked. The mean value for Plaque Index—1.4 (SD 0.61)—was higher in the smokers group than in the non-smokers group—1.27 (SD 0.61), both for the entire sample and in every age group. The mean values for the Calculus Index were higher in smokers compared with the same mean in every age group of non-smokers. Higher plaque accumulation ($P=0.001$) and calculus deposits ($P=0.003$) were found in the smokers group compared with non-smokers group. Periodontal condition as assessed by CPITN showed that there were statistically significant differences between smokers and non-smokers in the overall sample, with non-smokers more likely to have CPITN scores of 1 (gingival bleeding; $P=0.03$) and 3 (shallow pockets; $P=0.008$) than smokers and smokers more likely to have a CPITN score of 2 (calculus deposits; $P=0.03$). There was a trend for more smokers than non-smokers to have a CPITN score of 4 (deep pockets) but there was no statistically significant difference for this score between the two groups. **Conclusion:** In the sample studied, smoking was associated with more plaque and calculus depositions and less gingival bleeding. There was also a trend for smokers to be more likely to have deep pockets. Surprisingly, more non-smokers than smokers were assessed as having shallow pockets.

Key Words: Periodontal Disease, Smoking, Dental Plaque, Dental Calculus, CPITN

Introduction

There is general consensus that cigarette smoking represents a real environmental risk factor in the pathogenesis of chronic periodontitis. The role of cigarette smoking has been extensively reported in case-control, cross-sectional, longitudinal, and intervention studies.

Periodontal breakdown has been shown to be more severe among current smokers compared to

former smokers. Those who have never smoked have been observed to have the lowest risk [1,2,3,4,5,6,7]. One study has concluded that smoking *per se* has no effect and that differences are due to higher plaque levels in smokers than non-smokers [8].

It has also been suggested that tobacco smoking is accompanied by an increased likelihood of subgingival dental calculus deposition [9].

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It has been observed that smokers with periodontal disease display less gingival inflammation and gingival bleeding [10,11] when compared to non-smokers. Most, if not all, studies have used a variety of measures or endpoints to indicate that prevalence as well as severity of chronic periodontal disease is negatively influenced by smoking, from a modified gingival haemorrhagic response [10,11] to an elevated tooth mortality rate [12,13,14].

According to the European Study Program of Alcohol and Drugs (ESPAD) study [15], 64% of the young Romanian population were smokers in 2004, which represented an 11% higher incidence of smoking in the young population than reported in 1999. A report of the Romanian Health Ministry in 2000 revealed that 39% of the female population and 54% of the male population were smokers and that 47.5 % of the smokers started to smoke at 15-19 years of age and 33.8% of the smokers started to smoke at 20-24 years of age [16].

Many stop-smoking campaigns are currently informing the population regarding the negative effects of cigarette smoking. However, in these campaigns little and rather inexact information is offered about the negative effects of smoking on oral health.

Aim

Against this background, the aim of this study was to evaluate the effects of smoking on the periodontal tissues of patients who attended the dental clinics of the Faculty of Dentistry of the Ovidius University, Constanta, Romania, by assessing the Community Periodontal Index of Treatment Need (CPITN) score, plaque and calculus accumulation in smokers and non-smokers, and testing these variables for correlations with smoking or not smoking.

The null hypothesis was that there would be no significant clinical differences regarding plaque deposits, calculus accumulation, and CPITN scores between smokers and non-smokers.

Methods

1. Study sample

The initial study sample consisted of 528 males and females, aged 18-65 years, living in the metropolitan area of Constanta city and who requested dental care from the clinics of the Faculty of the Dentistry of the Ovidius University, Constanta.

The sample was a convenience sample and consisted of all new patients who met the inclusion

criteria and were examined and treated between January 2007 and June 2008 by the four examiners who took part in the study.

The final study group included 483 individuals and comprised 211 (43%) males and 272 (57%) females. Subjects were divided according to age into the following groups: under 35 years old, 35-44 years old, 45-55 years old, and over 55 years old. *Table 1* shows the distribution of study group by age groups. A total of 34 patients from the original sample did not take part in the study, 19 because they were unable to complete the written questionnaire properly and 15 who answered the questions but refused to be examined clinically. Eleven patients who completed the questionnaire and were examined reported that they had quit smoking and were also excluded.

2. Subject eligibility

A full medical history was taken from all potential subjects for the study. Subjects qualifying for the study met the following key inclusion criteria:

- Over 18 years of age and not older than 65 years of age.
- More than 10 natural teeth.
- Regular manual or electric toothbrush users.

Patients were excluded for one of the following reasons:

- Periodontal health, with no clinical signs of periodontal inflammation (CPITN=0).
- Chronic systemic pathology, such as diabetes, other endocrine pathologies, haematological pathologies, hypertension.
- Long-term medication known to affect the periodontal status within four weeks of the clinical examination, such as antibiotics, calcium channel blockers, cyclosporin.
- A history of alcohol or drug abuse.

3. Questionnaire

A questionnaire (*Figure 1*) were developed. It included questions on oral hygiene habits, smoking habits, and the number of years of smoking. The questionnaire was piloted on a group of 16 dental students.

Only data from the responses to questions 1, 2, 9 and 10 are presented in this paper. The other data, not relevant for the aim of this study, will be reported in future publications.

In order to assess the reliability of the data on smoking, which (like all the other data) were self-reported, 40 patients from the study sample were re-interviewed a second time by the examiners. The

Patient Name:Sex M/F
 Age: Address:
 Occupation:

Please give only one answer to each question

1. How often do you brush your teeth each day?

☐ 1 ☐ 2 ☐ 3 ☐ After each meal ☐ Never

2. How many minutes do you brush your teeth for ?

☐ 1 ☐ 2 ☐ 3 ☐ 4, ☐ over 4 minutes.

3. What type of toothbrushing movements do you employ?

☐ Vertical ☐ Horizontal ☐ Combined

4. Do you use a mouthwash?

☐ Yes ☐ No

If yes, how often?

☐ 1/day ☐ 2/day ☐ 3-day ☐ more than 3/day

5. Which secondary methods for plaque control do you use?

☐ Dental floss ☐ Interdental brushes ☐ Toothpicks ☐ None

6. Do you, or did you use an electric toothbrush?

☐ Yes ☐ No

7. On what is your daily diet mainly based:

☐ Potato chips ☐ Vegetables ☐ Pasta ☐ Milk products ☐ Meat

8. Do you have bleeding gums?

☐ Yes ☐ No

If yes, are these:

☐ Spontaneous ☐ Provoked ☐ Unconstant

9. Do you have any health problems?

☐ Yes ☐ No

If yes, please give details.....

10. Do you smoke?

☐ Yes ☐ No ☐ I quit smoking

11. If you are smoker, for how many years have you smoked?

☐ 1-5 years ☐ 6-10 years ☐ 11-19 years ☐ Over 20 years

12. If you are smoker, how many cigarettes do you smoke daily?

☐ 1-10 cigarettes ☐ 11-20 cigarettes ☐ 21-40 cigarettes ☐ Over 40 cigarettes

13. How do you rate your current oral hygiene status?

☐ Excellent ☐ Good ☐ Fair ☐ Poor

Figure 1. Questionnaire regarding correlation between oral hygiene and periodontal status.

second interview was made between one and four days after the first and no significant differences in the answers were noted.

4. Clinical examination

All permanent fully erupted teeth, excluding third molars, were examined with the manual CPITN periodontal probe, in accordance with the protocol recommended by the World Health Organization (1997). Four sites per tooth were assessed (i.e. the mesiobuccal, distobuccal, distolingual, and mesiolingual sites), in order to determine the CPITN score.

Plaque and calculus were assessed using the techniques for the Simplified Oral Hygiene Index (OHI-S) of Greene and Vermillon (1960, 1964). Both plaque and supragingival calculus were assessed on six selected surfaces (buccal surfaces of teeth 16, 26, 11, 31, and lingual surfaces of teeth 36, 46). If there was no first molar, the second molar was examined; if there was no central incisor, the lateral incisor was examined. The scores for the six surfaces were recorded, together with the CPITN score, on specially prepared record charts, the plaque and calculus scores were added together and divided by six to give mean plaque and calculus indices. In order to obtain consistency, the four examiners trained together before the study commenced and observed each other carrying out clinical examinations. However, no formal calibration with the calculation of percentage agreement or kappa scores was performed.

5. Ethics

The ethical committee of the Constanta Dental Medicine Faculty approved the study. Patients who agreed to participate signed an informed consent

form. At the conclusion of the study, the participants were provided with oral health instructions and a specific periodontal treatment plan.

6. Data analysis

The distributions of the dependent variables expressing the plaque and calculus scores for both smokers and non-smokers were not normal. Statistical analysis was performed using non-parametric methods Wilcoxon tests for unpaired observations (to test the correlation between PI, CI, toothbrushing frequency, toothbrushing time in smokers and non-smokers). The chi-square test was used to test whether the variables had normal or non-normal distribution. Statistical significance was accepted at $P < 0.05$.

Results

The age and smoking characteristics of the study population are presented in *Table 1*. The mean age of the study group was 38 years (SD 17.8), with a mean of 43 years (SD 19.4) in the non-smokers group and 32 years (SD 13.3) in the smokers group. From these data, it can be seen that the smokers group includes younger subjects than the non-smokers group.

Young adults under 35 years represented the majority of the study population (i.e. 55% of the total sample). Overall, 45% of this adult population, or 219 individuals, were active smokers. In the oldest age group (over 55 years), only a small proportion (17%) were current smokers (*Table 1*).

Fifty-eight percent ($n=123$) of the male population and 35% ($n=96$) of the female population reported that they smoked (*Table 2*).

Table 1. Study Group According to Age and Smoking

Age (years)		18-65 n (%)	<35 n (%)	35-44 n (%)	45-55 n (%)	>55 n (%)
Sample	Total	483 (100)	267 (55)	54 (11)	39 (8)	123 (25)
	Non-smokers	264 (55)	117 (44)	25 (46)	20 (51)	102 (83)
	Smokers	219 (45)	150 (56)	29 (54)	19 (49)	21 (17)
	*Quit smokers	11	6	0	1	4
Mean age (SD)	Total	38 (17.78)	24 (3.67)	39 (2.85)	51 (2.52)	65 (5.76)
	Non-smokers	43 (19.43)	24 (3.85)	38 (2.64)	52 (2.01)	65 (6.05)
	Smokers	32 (13.32)	24 (3.44)	38 (3.03)	50 (2.65)	63 (4.18)

* The 11 quit smokers shown in *Table 1* were not included in any analyses and are not included in the final total sample of 483

Table 2. Number and Percentage of Smokers According to Gender

	Males n (%)	Females n (%)
Smokers	123 (58)	96 (35)
Non-smokers	88 (42)	176 (65)

The overall mean value of the Plaque Index (PI) was higher in smokers compared with non-smokers, both overall and in every age group (Table 3). There was a positive correlation between smoking and plaque accumulation level. $P=0.001$ (Wilcoxon unpaired test).

The mean value of the PI increased with age in both smokers and non-smokers (Table 3), which might suggest that the young patients paid more attention to their oral hygiene than the older patients.

According to the self-reported oral hygiene practices, the mean toothbrushing frequency in smokers was slightly higher (i.e. 2.05 times per day; SD 0.97) compared with the non-smokers group (i.e. 1.99 times per day; SD 0.97). Smokers also reported that they brushed their teeth for longer than non-smokers (Table 4). These data were not statistically significant ($P=0.4680$ for brushing frequency and $P=0.1444$ for toothbrushing time).

Table 4. Oral Hygiene Practices in Smokers and Non-Smokers

	Toothbrushing frequency/ times per day Mean (SD)	Toothbrushing time/ minutes Mean (SD)
Total	2.02 (0.97)	2.52 (1.03)
Non-smokers	1.99 (0.98)	2.48 (1.11)
Smokers	2.05 (0.97)	2.57 (0.92)

In non-smokers, the mean coefficients for the Calculus Index (CI) ranged between 0.57 (SD 0.55) in young adults (aged under 35 years) and 1.15 (SD 0.74) in age group 45-55 years. The mean values for CI were higher in every age group of smokers compared with non-smokers (Table 5).

The overall differences in mean calculus accumulation were statistically significant between the overall group of smokers and the overall group of non-smokers: $P=0.003$ (Wilcoxon unpaired test).

The null hypothesis that there would be no significant clinical differences regarding plaque deposits and calculus between smokers and non-smokers was tested. It revealed positive differences between PI and CI in smokers evaluated in the whole study group, who exhibited higher plaque and calculus accumulation.

Table 3. Plaque Index (PI) According to Age and Reported Smoking

PI		Total	<35	35-44	45-55	>55
Mean PI (SD)	Total	1.34 (0.62)	1.17 (0.57)	1.48 (0.63)	1.47 (0.59)	1.57 (0.63)
	Non-smokers	1.27 (0.61)	1.03 (0.56)	1.41 (0.62)	1.30 (0.61)	1.48 (0.57)
	Smokers	1.40 (0.61)	1.27 (0.57)	1.55 (0.64)	1.66 (0.54)	1.86 (0.62)

Table 5. Calculus Index (CI) According to Age and Reported Smoking

CI		Total	<35	35-44	45-55	>55
Mean CI (SD)	Total	0.91 (0.64)	0.71 (0.54)	1.18 (0.67)	1.21 (0.7)	1.14 (0.67)
	Non-smokers	0.84 (0.66)	0.57 (0.55)	0.99 (0.69)	1.15 (0.74)	1.06 (0.65)
	Smokers	0.99 (0.62)	0.82 (0.53)	1.33 (0.62)	1.31 (0.69)	1.51 (0.66)

Table 6. CPITN Scores According to Reported Smoking

CPITN scores	Bleeding n (%)	Calculus n (%)	Shallow pockets n (%)	Deep pockets n (%)	Total n (%)
Smokers	17 (8)	137 (63)	35 (16)	30 (14)	219 (100)
Non-smokers	40 (15)	117 (44)	78 (30)	29 (11)	264 (100)
P values*	0.03	0.03	0.008	0.5	

* Using the chi-square test

Periodontal condition as measured by maximum CPITN score per person showed that in the group studied there were statistically significant differences between smokers and non-smokers for CPITN scores of 1 ($P=0.03$; non-smokers more likely to have gingival bleeding), 2 ($P=0.03$; smokers more likely to have calculus present), and CPITN 3 ($P=0.008$; non-smokers more likely to have shallow pockets) but not for the CPITN score of 4 (deep pockets, where $P=0.5$) (Table 6).

Discussion

It has been estimated that about a third of the male adult global population smokes [17]. This is in agreement with the results of our study, as most of the smokers were male. Among the young, about one in five smokes worldwide. Between 80,000 and 100,000 children worldwide start smoking every day [17]. In the current study, 56% of all smokers were young adults under 35 years of age.

Other data show that in the United States of America, an estimated 26.2 million men (23.5%) and 20.9 million women (18.1%) were smokers (2006) [18], much lower percentages than in the current study.

On 1st January 2009, Constanta city had a population of 302,171 inhabitants [19]; 0.16% (483) of this population was included in the study. The results of this study cannot be generalized to the whole population of Constanta, because the investigated group is not representative of the population, but includes only patients who sought dental treatment from the Dental Faculty's clinics, where the low cost of dental treatment attracts a population that, in general, is largely made up of people with a low income and students.

Almost half of the patients in this urban adult Romanian population were active smokers (45%), which represents a very high incidence of smoking habit in this study population, as well as worldwide. As mentioned above, the proportion of smokers was highest (56%) in the youngest group (i.e. aged under 35 years) and lowest (17%) in the oldest (i.e. over 55 years). These data are of great concern, because smoking can affect the oral and systemic health condition of today's young population who in future will require considerable human and financial resources to manage their health problems. It is possible that the older population does not smoke (or has quit smoking) due to high costs of this habit. It is also possible that a higher proportion of older patients either had fewer than 10

remaining teeth, and were either taking long-term medication, or had a medical condition that excluded them from the study. The chances of starting smoking decreases as age increases [20], so it is important to organise efforts and support for youngsters to prevent them from starting smoking and to motivate them to quit smoking as soon as possible.

In our study group, 58% of the male population and 35% of the female population declared that they smoked. According to the European Study Program of Alcohol and Drugs (ESPAD) study, in 2004, 54% of the Romanian male population and 39% of its female population were smokers [15]. Our findings are similar to the official 2004 data regarding gender distribution of Romanian smokers, although our study group is not considered representative for the whole Romanian population.

In previous clinical investigations, more gingivitis, higher PI, higher CI, and poorer oral hygiene have been observed among smokers [9,10,11]. In 1987, Bergström conducted a survey of 79 smokers and 59 non-smokers with similar levels of plaque and found that the incidence of pockets measuring 4 mm and more was significantly higher among smokers [21].

Other investigations have shown little difference in the level of plaque accumulation, comparing smokers with non-smokers [22,23]. In the present study, a higher level of plaque accumulation in smokers compared with non-smokers was observed in the total population, as well as in each age group separately.

The CPITN scores confirmed the result obtained from the use of the CI in that there was a statistically significant difference (more smokers) in the number of smokers with a CPITN score of 2 than of non-smokers. Although there was a trend towards more smokers having a CPITN score of 4 (deep pockets), there was no statistically significant difference between the two groups. This finding is in agreement with that from two studies [24,25], whose authors reported that smokers do not have more deep pockets compared with non-smokers. However, as explained in the introduction to this paper, the majority of studies have found that smokers have more periodontal breakdown than non-smokers. In the current study, the relatively small numbers of patients with a CPITN score of 4 may have led to the finding of no statistically significant difference between the two groups for this score.

The finding that there was a statistically significant difference between the two groups, with more non-smokers than smokers exhibiting a CPITN score of 1 (gingival bleeding) was unsurprising, as it has been suggested that smokers suffer less from gingival bleeding but more from attachment loss [10,11]. As described above, there was a trend for more smokers to have a CPITN score of 4 (deep pockets), which, in view of the findings of previous studies [1,2,3,4,5,6,7,21], was to be expected. However, the finding that more non-smokers than smokers had a CPITN score of 3 (shallow pockets) and that this difference was statistically significant was surprising, particularly as the numbers in each CPITN 3 group were not especially small. The authors have no explanation for this finding.

The relationship between smoking and periodontitis has been based on a self-reported assessment of tobacco consumption in most studies, including the current one. Self-reporting may be influenced by cultural and social factors, and the effects of smoking on health may also be influenced by individual variations because of differences in metabolism, depth of inhalation, and nicotine concentration in cigarettes. An alternative approach to self-reporting may include the assessment of specific metabolites, such as cotinine, which are present in serum following tobacco consumption. The assessment of metabolites, however, can only be used to measure smoking levels in current smokers [26, 27].

Within the limitations of this study, slightly better oral hygiene, as measured by self-reported toothbrushing frequency, was found in smoker

groups than in non-smokers. However, this was not reflected in the mean plaque scores, which were higher for smokers both overall and in each age group, suggesting that the non-smokers may have been more effective toothbrushers.

A controlled study with controlled oral hygiene habits is recommended in the future to assess the difference in the periodontal status between smokers and non-smokers.

Because smoking is also an important risk factor for other diseases, another area for future work is a common risk factor approach which would be to include periodontal diseases in ongoing or planned intervention campaigns in Romania designed to prevent smoking-related diseases.

Conclusion

In this study smoking was associated with higher plaque and calculus deposits. The CPITN assessments indicated that in the group studied:

- Non-smokers were more likely to have a CPITN score of 1 (gingival bleeding).
- Smokers were more likely to have a CPITN score of 2 (presence of calculus).
- Surprisingly, non-smokers were more likely to have a CPITN score of 3 (shallow pockets).
- There was no statistically significant trend for smokers to be more likely to have a CPITN score of 4 (deep pockets).

Acknowledgements

The authors want express sincere appreciation to Dr. Roos Leroy for her critical appraisal of the paper. They are also grateful to Corneliu Puscasu, Dipl. Eng., for help with the statistical analysis.

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