

Comparison of Clinical and Radiographic Periodontal Status Between Habitual Water-Pipe Smokers and Cigarette Smokers

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Background: There is a dearth of studies that have compared clinical and radiologic markers of periodontal inflammation between water-pipe smokers (WPs) and cigarette smokers (CSs). The aim of the present study is to compare the clinical and radiographic periodontal status between habitual WPs and CSs.

Methods: In total, 200 males (50 WPs, 50 CSs, and 100 controls) with comparable mean age and education were included. Demographic information was recorded using a questionnaire. Periodontal parameters (plaque index [PI], bleeding on probing [BOP], probing depth [PD], clinical attachment loss [AL], and marginal bone loss [MBL]) and numbers of missing teeth (MT) were recorded.

Results: The duration of each smoking session for WPs and CSs was 50.2 ± 6.7 and 15.3 ± 0.4 minutes, respectively. Number of MT [$P < 0.0001$], PI [$P < 0.0001$], AL [$P < 0.0001$], PD ≥ 4 mm [$P < 0.0001$], and MBL [$P < 0.0001$] was significantly higher among WPs and CSs than controls. BOP was significantly higher among controls than WPs ($P < 0.0001$) and CSs ($P < 0.0001$). There was no statistically significant difference in the aforementioned parameters between WPs and CSs.

Conclusions: Males in a Saudi Arabian community who were CSs or WPs had more MT and poorer periodontal condition than never smokers. The periodontal condition of WPs was equally as poor as CSs. Additional clinical observational studies with emphasis on sex and sociodemographic characteristics are needed. *J Periodontol* 2016;87:142-147.

KEY WORDS

Alveolar bone loss; dental plaque; inflammation; periodontal index; smoking.

Water pipe (also known as hookah, hubble-bubble, goza, narghile, and sheesha) is a form of smoking that involves the passage of charcoal-heated air through a perforated aluminum foil and across flavored tobacco to become smoke that bubbles through water before being inhaled. The tobacco used for water-pipe smoking (WPS) contains 2% to 4% nicotine. WPS is common in many Middle Eastern countries, including Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, and the United Arab Emirates.¹⁻⁸ However, it is pertinent to mention that, because of the increasing popularity of WPS as a behavioral/recreational activity, this form of smoking has made its way into several Western countries, including Australia, Canada, the United Kingdom, and the United States.⁹⁻¹⁵ This is also likely attributable to increasing mobility of user populations across these countries. Many individuals also have the perception that WPS is not addictive and less harmful than cigarette smoking.¹⁶ Because of its growing use particularly among the young, WPS has turned into a grave issue of global health and environmental concern.⁷ Increased blood carboxyhemoglobin levels, impairment of pulmonary function, and increase in heart rate and blood pressure are among the reported detrimental effects of WPS on health.¹⁷⁻¹⁹

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The detrimental effects of cigarette smoking on oral and systemic health have been reported extensively.²⁰⁻²⁴ Studies have reported that clinical and radiographic parameters of periodontal inflammation (such as probing depth [PD] ≥ 4 mm, clinical attachment loss [AL], and marginal bone loss [MBL]) are worse and numbers of missing teeth (MT) are higher among habitual cigarette smokers (CSs) than those who have never smoked.²⁵⁻²⁸ Moreover, smokers may remain unaware of the ongoing periodontal inflammatory process for a prolonged duration of time.²³ This is mainly attributable to the vasoconstrictive effect of nicotine on gingival blood vessels, which suppresses bleeding on probing (BOP) in smokers compared with non-smokers.²⁹ To the best of the authors' knowledge, there is a dearth of studies that have assessed the periodontal health status of habitual water-pipe smokers (WPs). In a recent study, Bibars et al.³⁰ assessed plaque index (PI), BOP, calculus index (CI), AL, and PD >3 mm among CSs, WPs, and controls. The age-adjusted results showed significant differences in odds ratios (ORs) for PI, BOP, CI, AL, and PD >3 mm between CSs and WPs compared with non-smokers.³⁰ These results also showed no significant difference in the aforementioned parameters and CSs and WPs.³⁰ However, other parameters, such as the number of MT and MBL, were not investigated in the study by Bibars et al.³⁰ It is hypothesized that: 1) MBL and number of MT are significantly higher in WPs and CSs compared with controls, and 2) there is no significant difference in MBL and number of MT between WPs and CSs. Hence, the aim of the present study is to compare the clinical and radiographic periodontal status between habitual WPs and CSs to quantify the effects of these behaviors.

MATERIALS AND METHODS

Ethical Guidelines

The study was approved by the Research Ethics Review Board of the College of Applied Medical Sciences, King Saud University, Riyadh, Saudi Arabia. Individuals who volunteered to participate in the study were presented a consent form. It was mandatory for all study participants to have read and signed the consent form before being included in the present study.

Eligibility Criteria

The inclusion criteria were as follows: 1) self-reported systemically healthy individuals; 2) habitual WPs; 3) habitual CSs; and 4) individuals who reported to have never used tobacco in any form. The exclusion criteria were as follows: 1) dual smokers (individuals smoking both cigarettes and a water pipe); 2) individuals with self-reported systemic diseases, such as diabetes mellitus, human immunodeficiency virus

infection/acquired immunodeficiency syndrome, cardiovascular diseases, hepatic disorders, renal disease, and epilepsy; 3) edentulous individuals; 4) individuals with crowded teeth or occlusal trauma; 5) self-reported habitual alcohol consumers and tobacco chewers; 6) lactating and/or pregnant females; 7) individuals who reported having used antibiotics, non-steroidal anti-inflammatory drugs, and/or steroids within the past 3 months; and 8) individuals who reported to have undergone periodontal treatment within the past 6 months.

Study Participants

Between December 2013 and September 2014, a convenience sample of individuals was recruited at the dental department of the College of Applied Medical Sciences, King Saud University. Individuals visiting the dental clinic for treatment were approached randomly, and an information sheet was presented to the individuals that explained the purpose of the study. Those included in the study (200 males, aged 43 to 57 years; mean age: 47.1 years) were self-reported systemically healthy males who were either habitual WPs, habitual CSs, or had never used tobacco in any form (controls). The WP group consisted of individuals who reported smoking solely a water pipe at least once daily for at least the past year. The CS group consisted of individuals who reported smoking at least one cigarette daily for at least the past year.²⁶ Controls were defined as individuals who reported to have never consumed tobacco in any form.²⁶ Clinical and radiographic examinations were performed at the College of Applied Medical Sciences, King Saud University.

Questionnaire

A trained interviewer (AAA-K), masked to the study groups, presented the questionnaire to all participants. A questionnaire was used to collect data regarding age, sex, education status, duration of cigarette smoking and WPS in years, daily frequency of WPS and cigarette smoking, duration of each smoking session (in minutes), and family history of smoking. Information regarding daily oral hygiene maintenance protocols was collected.

Clinical Periodontal Parameters and MT

A calibrated and trained investigator (AAA-K), masked to the study groups, performed the periodontal clinical examinations. Full-mouth PI,³¹ BOP,³² PD,³³ and AL³⁴ were measured at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, disto-lingual/palatal, mid-lingual/palatal, and mesio-lingual/palatal) on all maxillary and mandibular teeth (excluding third molars). A graded probe[¶] was used to measure PD to the nearest millimeter.²⁶ Numbers of MT were counted and recorded. Broken-down

¶ Hu-Friedy, Chicago, IL.

teeth with embedded root remnants were considered as missing.

Radiographic Parameter

Full-mouth digital radiographs including bitewings[#] were taken and viewed on a calibrated computer screen** using a software program.^{††} MBL (defined as the vertical distance from 2 mm below the cemento-enamel junction [CEJ] to the most crestal part of marginal bone)²⁶ was measured on all teeth (excluding third molars). Surfaces of teeth on which the CEJ or the bone crest were not visible because of technical reasons (such as dental caries, dental restorations, malocclusion, and/or poor radiographic quality) were excluded. A trained and calibrated investigator (AAA-K) performed all radiographic assessments.

Statistical Analyses

Descriptive statistics of variables (clinical parameters, number of MT, and MBL) in each group were reported. Shapiro-Wilk test was used to test the normality assumption of the distribution of each variable in the three groups. The one-way analysis of variance (ANOVA) was used to compare the mean values of each variable among three groups. Tukey multiple comparison test was used for pairwise comparison, controlling for the overall Type I error. The significance level was set at 0.05 for all comparisons. The statistical analyses were implemented with statistical software.^{‡‡} The sample size calculation was based on the comparison of PI among the three groups. It was proposed that the mean PI among non-smokers, CSs, and WPs are 34%, 40%, and 45%, respectively, with common standard deviation of 20. One-way ANOVA shows that a total of 188 individuals (94, 47, and 47, respectively) has 85% power to detect the proposed difference (with significance level of 5%). Finally, 200 individuals (100, 50, and 50, respectively) were recruited in the study.

RESULTS

General Characteristics of the Study Population

A total of 200 individuals (50 WPs, 50 CSs, and 100 controls) were included in the study. All participants were males. The mean age and educational levels were comparable among WPs, CSs, and controls. The duration of smoking habit between WPs and CSs in years was 20.5 ± 2.8 and 22.3 ± 6.5 years, respectively. WPs and CSs reported smoking 4.7 ± 1.1 and 15.4 ± 3.6 times daily, respectively. The duration of each smoking session for WPs and CSs was 50.2 ± 6.7 and 15.3 ± 0.4 minutes, respectively. A family history of smoking was 40% of WPs, 66% of CSs, and 14% of controls (Table 1).

Periodontal Parameters Between Habitual WPs and CSs

The mean \pm SD of each parameter in each group are shown in Table 2. Shapiro-Wilk test showed that the normality assumption was reasonable for all parameters. Hence, for each parameter, the one-way ANOVA was used to compare the differences among three groups. Tukey pairwise comparison showed that PI ($P < 0.0001$), BOP ($P < 0.0001$), PD ≥ 4 mm ($P < 0.0001$), AL ($P < 0.0001$), MBL ($P < 0.0001$), and numbers of MT ($P < 0.0001$) were significantly higher in WPs and CSs compared with controls. There was no statistically significant difference in PI, BOP, PD, AL, MBL, and numbers of MT between CSs and WPs.

DISCUSSION

The present results showed that PI, PD ≥ 4 mm, and AL were significantly higher for WPs and CSs than controls. These outcomes are in accordance with a previous study;³⁰ however, to the best of the authors' knowledge, the present study is the first one that compared MBL and numbers of MT (in addition to PI, BOP, PD ≥ 4 mm, and AL) among the aforementioned groups. An interesting finding in the present study was that PI, PD ≥ 4 mm, AL, MBL, and numbers of MT were comparable between WPs and CSs. It is known that water pipes and cigarettes expose their consumers to the same chemicals, such as carbon monoxide, tar, and nicotine.³⁵⁻³⁷ Moreover, nicotine has been suggested to upregulate the secretion of proinflammatory cytokines (such as interleukin-1 β) that promote alveolar bone loss.³⁸ Furthermore, relative to a single cigarette, a single water-pipe episode is associated with similar peak plasma nicotine levels.³⁹ These could be possible explanations for the similarity in periodontal parameters and MBL between WPs and CSs compared with controls. It has been reported that nicotine has a vasoconstrictive effect on gingival blood vessels, which suppresses BOP.⁴⁰ In a clinical study by Natto et al.,⁴¹ WPs showed a tendency toward suppressed gingival bleeding compared with controls. The present study supports the experimental and clinical results by Clarke and Shephard⁴⁰ and Natto et al.⁴¹

The mean numbers of MT were significantly higher in WPs and CSs than controls. In the present study, CSs were smoking ≈ 15 cigarettes daily for nearly 22 years. This is similar to recent results by Morse et al.,²⁸ who showed that CSs who smoked at least 15 cigarettes daily for 27 years had significantly greater numbers of MT compared with controls. Moreover, it

Ektaspeed plus, Kodak, Rochester, NY.

** Samsung SyncMaster digital TV monitor, Suwon City, Gyeonggi-do, Korea.

†† Image Tool v.3.0, Department of Dental Diagnostic Science, University of Texas Health Science Center, San Antonio, TX.

‡‡ SAS v.9.4, SAS, Cary, NC.

is noteworthy that WPs and CSs were exposed daily to tobacco smoke for similar time durations, that is, ≈ 200 minutes. This could be an explanation for the similarity in the severity of periodontal conditions among these individuals compared with controls. Some studies⁴²⁻⁴⁴ use the unit “pack-years” to determine a dose relation between cigarette smoking and periodontal disease, which is calculated by multiplying the number of packs of cigarettes smoked daily by the number of years the person has smoked. However, it seems difficult to use this unit to predict a dose relation between WPS and periodontal disease, most likely because cigarettes are available in “packs” and water-pipe tobacco is sold in “loose” form.

In the present study, mean age and graduate-level education (post 4-year college degree) status were comparable among WPs, CSs, and controls (Table 2). This suggests that smoking was a factor that could have influenced the periodontal parameters among WPs, CSs, and controls. Because WPS is a cultural and social norm in many Middle Eastern countries, it is possible that the easy access and cultural influence may convince many individuals (par-

ticularly the young) to acquire this habit. Inclusion of tobacco cessation programs as a part of routine dental treatment should also be encouraged in routine dental practices. It is highly recommended that community health awareness programs should routinely be performed to educate people about the detrimental effects of smoking (including the emerging use of electronic cigarettes [e-cigarettes] on health).⁴⁵

The present results reflect that there were no smokers (either WPs or CSs) without remarkable MBL. It is known that an underprivileged socioeconomic status (SES) and poor educational status are significant risk factors of periodontal disease and MBL.^{26,46} Regrettably, these parameters remained uninvestigated in the present study; however, because the periodontal status of WPs and CSs were significantly poorer than controls, it is hypothesized that the SES and education status of WPs and CSs were also compromised compared with controls. In this regard, the role of SES and poor education that could have differentially affected the risk of periodontitis in both groups of smokers compared with controls cannot be excluded. Another limitation of

Table 1.
General Characteristics of Study Groups

Parameters	WPs (n = 50)	CSs (n = 50)	Controls (n = 100)
Mean age \pm SD (years)	48.5 \pm 6.2	50.1 \pm 3.5	46.5 \pm 4.2
Duration of smoking \pm SD (years)	20.5 \pm 2.8	22.3 \pm 6.5	—
Daily frequency of smoking	4.7 \pm 1.1	15.4 \pm 3.6	—
Duration of each smoking session (minutes)	50.2 \pm 6.7	15.3 \pm 0.4	—
Family history of smoking (%)	40	66	14
Graduate-level education status (%)	56	60	65

Table 2.
Descriptive Statistics of Periodontal Parameters Among Habitual WPs, CSs, and Controls

Parameters	CSs (n = 50)	WPs (n = 50)	Controls (n = 100)
PI (%)	63.1 \pm 9.3*	67.3 \pm 11.7*	24.4 \pm 7.9
BOP (%)	5.5 \pm 1.3*	6.2 \pm 3.9*	14.5 \pm 4.8
PD \geq 4 mm (%)	34.6 \pm 12.3*	30.1 \pm 11.3*	4.6 \pm 2.2
AL (in mm)	5 \pm 0.8*	4.7 \pm 1*	0.5 \pm 0.5
MBL (in mm)	5.6 \pm 1.2*	5.1 \pm 0.8*	2.2 \pm 0.9
Number of MT (n)	17.1 \pm 3.6*	15.2 \pm 3.2*	5.2 \pm 4

Values are presented as mean \pm SD.

* $P < 0.0001$, compared with controls.

the present study is that the results were based on a convenience sample. Furthermore, all individuals who agreed to participate in the present investigation were males. Although females had been invited to participate in the present study, none of them volunteered. It was hypothesized that periodontal inflammation is worse and numbers of MT are higher among dual-smokers (individuals smoking both a water pipe and cigarettes) compared with individuals smoking solely water pipes or cigarettes. Additional studies are needed to test the aforementioned hypothesis, including the currently emerging e-cigarette vaping across the world.⁴⁵

CONCLUSIONS

Males in a Saudi Arabian community who were CSs or WPs had more MT and poorer periodontal condition than never smokers. The periodontal condition of WPs was equally as poor as CSs. Additional clinical observational studies with emphasis on sex and sociodemographic characteristics are needed.

ACKNOWLEDGMENTS

The authors extend sincere appreciation to the Deanship of Scientific Research, King Saud University, Saudi Arabia for funding/supporting this research through Research Group No-IRG 14-31. The authors report no conflicts of interest related to this study.

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Submitted April 9, 2015; accepted for publication August 22, 2015.