Original Research Article

Periodontal status among adult cigarette smokers using Miswak (*Salvadora persica*) for oral hygiene: A cross-sectional study from Asir Region of Saudi Arabia

Mukhatar A Javali*, Betsy Joseph, Nabeeh A AlQahtani, Mohasin Abdul Khader, Shahabe Saquib Abullias, Saad M AlQahtani

Department of Periodontics and Community Dental Sciences, Division of Periodontics, College of Dentistry, King Khalid University, Abha, Kingdom of Saudi Arabia

*For correspondence: **Email:** jmahmad@kku.edu.sa; **Tel:** 00966580540089*

Abstract

Purpose: To compare the periodontal status of exclusive users of Miswak (Salvadora persica) with that of exclusive toothbrush users among adult smokers of cigarettes in Saudi Arabia.
Methods: This educational-institutional study included one hundred and fifty adult patients (age and socioeconomic status matched, SES) between the ages of 18 and 75, and were listed as the group I, II, and III, with 50 participants each (participants with no oral hygiene, toothbrush users and miswak users respectively). Oral hygiene habits, the number of cigarettes smoked, and time since the habit began. Periodontal and radiographic parameters were reported.
Results: All parameters related to periodontium (plaque index (PI), gingival index (GI), bleeding on probing (BOP), probing pocket depth (PPD), gingival recession (Rec), clinical attachment level (CAL) and bone loss (BL)) showed that the analysed groups exhibited differences (p < 0.001). Least amount of BL (anterior and posterior) was found in toothbrush users and Miswak users, while least amount of attachment loss (both anterior and posterior) was recorded among Miswak users (p > 0.05). Positive association was found for GI (r = 0.753) and recession (r = 0.436, p < 0.001) in terms of the number of cigarettes smoked in group I, and anterior PPD (r = 0.388, p < 0.001) in group III for the duration of smoking. A negative correlation was found for BOP in group III (r = - 0.339, p < 0.05) in terms of frequency of tooth cleaning and GI (r = - 0.381) (p < 0.001) in group II, in terms of time taken attain oral hygiene.
Conclusion: This study indicates less severe periodontal damage among adult current cigarette smokers in miswak users than in toothbrush users. Thus, there some potentials for miswak use for promotion of oral hygiene.

Keywords: Periodontal status, Adult cigarette smokers, Miswak, Oral hygiene

INTRODUCTION

The use of cigarettes is regarded as a primary risk factor for periodontal disease causation [1].

Evidence of strong association between tobacco use and progressive periodontal damage is present in the literature [1]. Studies record significantly higher pocket depth scores in

smokers and alveolar bone loss than in non-smokers [2]. Oral hygiene aids have an essential part to play in avoiding periodontal disease. Among these, aside from antiplaque effects, herbal oral hygiene tools were anti-inflammatory and anticariogenic. Different sections of Miswak (drawn from a plant species of *Salvadora persica* belonging to the *Salvadoraceae* family) such as twigs, stem, and roots were used to extract plaque from the oral cavity [3], including interdental areas [4]. Miswak (*S. persica*) has a broad geographical range, and its beneficial properties are considered to be exercised by the fibres' abrasive effects and by the presence of therapeutic chemicals. It has been found that repeated Miswak chewing releases its sap, which can may have protective effects against caries [5]. Due to the essential oils, the slightly bitter taste of miswak acts as a buffering agent and activates salivation. It has been found high chloride concentrations inhibit calculus from forming and help remove stains from tooth surfaces [6]. The use of chewing sticks enhanced calcium saturation in saliva and facilitated enamel remineralization [7]. Miswak's roots are also considered to include chlorides, flavonoids, fluorides, tannins, saponins and sterols, sulphur and ascorbic acid [6].

It has been found that the use of miswak has a protective effect on the periodontium, caries, and low need for periodontal care [8] However, contradictory findings exist where miswak users have deeper periodontal pockets or just marginal better periodontal status than non-users [9]. Since there are insufficient data on periodontal status and bone loss in smokers who are miswak users, this study was done with the primary objective of determining whether there exists any difference in periodontal parameters selected for the study. Furthermore, the purpose of this study was also to determine the nature of the association between the number of cigarettes smoked and the duration of smoking or frequency with that of above listed clinical parameters.

METHODS

Study design

This educational institution-based cross-sectional study was performed between March 2019 and May 2019 in the outpatient department of King Khalid University, College of Dentistry. The Institutional Review Board at the College of Dentistry approved the study (no. SRC/ETH/2018-19/108). The research was performed in full accordance with the ethical standards of the Helsinki Declaration of the World Medical Association (version 2008). The participants had given informed consent before their enrolment in the study.

Consenting participants who were current cigarette smokers with periodontitis (according to AAP 2018) [10] using either toothbrush with a non-herbal fluoridated toothpaste or fresh miswak stick (twig) for oral hygiene maintenance were recruited for the study.One hundred fifty adult patients between 18 and 75 years were listed as group I (n = 50; no oral hygiene), group II (n = 50; toothbrush users) or group III (n = 50; Miswak users). Based on the mean ± SD of CAL in three groups of our pilot study, the effect size was determined to be 0.35 (taking likelihood alpha error 0.05 and 95 percent research power), and thus the sample size was estimated to be 129 i.e. 43 in each group. Therefore, the study included 150 patients (age and socioeconomic (SES) matched) from an existing list, taking into account 10 percent margin of error in each group). The exclusion criteria were those cases where cementoenamel junction (CEJ) or the bone crest was not identified adequately (overlapping, caries or restorations), presence of any systemic condition, family history of periodontal disease, periodontal therapy in the last six months, and systemic antibiotics within the last three months. Patients were given the definitive treatment following the registration of all relevant parameters.

Periodontal examination

Probing pocket depth, gingival recession, and interdental CAL was recorded at the most significant loss using the University of Michigan O probe with William's markings. Periodontal destruction was reported separately in the anterior and posterior segments in PPD, GR and CAL [11]. A patient was considered to have periodontitis if interdental CAL was detectable in two or more non-adjacent teeth, or if buccal or oral CAL of 3 mm or more with pocketing of3 mm or more was detectable at two or more teeth. This was following the new classification of periodontal disease (2018) [10]. However, CAL was not considered due to non-periodontitis-related causes such as dental caries spreading through the cervical region of the tooth; the presence of CAL distal to molars or associated with malposition or extraction of a third molar; an endodontic lesion draining through the marginal periodontium; and the occurrence of a vertical root fracture. Gingival inflammation and oral hygiene status were also assessed using GI and PI, while BOP was recorded using gingival bleeding index.

Radiographic examination

The amount of BL in each patient's worst affected tooth was recorded from crest of alveolar bone to cementoenamel junction (CEJ). BL was recorded separately in the anterior and posterior regions since nicotine exerts more destructive actions in the anterior region due to its vasoconstrictive effects [11]. The radiographic method used was similar technique (Kodak Ultra speed Dental Film, Eastman Kodak, Rochester, NY, USA) with a Siemens Heliodent MD model X1744 (Sirona Dental Systems, GmbH D-64625, Bensheim, Germany) in order to standardize. The X-ray machine used was a 70 kV and seven mA machine. Before the recording of clinical and radiographic parameters for the study, the two examiners evaluated these in five patients twice, 48 hours apart, to calibrate the readings. In case 90 percent or more of the recordings could reproduce within a 1- mm difference, then the calibration was accepted.

Statistical analysis

The data are expressed as mean ± SD (quantitative data) and numbers and percentages (qualitative data). Since the data was normally distributed, parameters such as oral hygiene practices (qualitative) and periodontal and radiographic parameters (quantitative) between different study groups were tested using Chi-square test and analysis of variance (ANOVA) along with post-hoc respectively at 95 % Confidence interval (CI). Correlation between various parameters was done using Pearson's analysis, and the results were expressed in terms of *p*-value and Pearson's Coefficient (r). Statistical analysis was done using SPSS 17.0 version.

RESULTS

One hundred and fifty patients (with a positive history of smoking) were found eligible to participate in the study following the inclusion and exclusion requirements. In each group, there were 50 patients (group I: no oral hygiene method used, 50 in group II (users of toothbrush), and 50 in group III (users of the miswak). Descriptive statistics for the demographic data between the various sample groups shown in Table 1 indicate no differences in age and SES ($p > 0.05$).

There was no statistically significant difference in terms of frequency of teeth brushing, the time taken for teeth brushing, the number of cigarettes smoked, and duration of smoking (Table 2). Although the highest number of cigarettes used every day was among patients of group III (11.52 ± 6.37 and the lowest in group II (9.90 ± 2.57), this difference was statistically insignificant ($p = 0.321$). The majority of group II and III subjects brushed their teeth once a day (48 % and 38 % respectively). Group II reported the most prolonged time of smoking cigarettes while it was shortest for group III, and this too showed no statistically significant difference ($p = 0.248$).

Table 1: Descriptive analysis of demographic variables amongst the different study groups

Variable	Response	Group I (n=50)		Group II (n=50)		Group III (n =50)		*P*-value
		n	%	n	%	n	%	
Age	Mean ± SD	34.08±6.51		34.98±8.98		36.84±6.51		0.169[ns]
SES	Lower	12	24	14	28	9	18	0.826[ns]
	Middle	28	56	26	52	29	58	
	Upper	10	20	10	20	12	24	

SES: Socioeconomic status; ns: not significant; *$p < 0.05$: significant; **$p < 0.001$: highly significant

Table 2: Comparative analysis of variables related to oral hygiene practices and smoking habits of subjects in each study group

Variable	Response	Group I (n=50)		Group II (n=50)		Group III (n=50)		*P*-value
		n	%	n	%	N	%	
Frequency	1	0	0	24	48	19	38	0.454[ns]
	2	0	0	10	20	15	30	
	3	0	0	16	32	16	32	
Time taken	1	0	0	28	56	25	50	0.767[ns]
	2	0	0	17	34	18	36	
	3	0	0	5	10	7	14	
No. of cigarettes	Mean ± SD	10.70±6.23		9.90±2.57		11.52±6.37		0.321[ns]
Duration	Mean ± SD	14.70±8.57		15.96±8.44		13.06±8.98		0.248[ns]

ns: not significant; *$p < 0.05$: significant; **$p < 0.001$: highly significant; SD: standard deviation

All the periodontal parameters (PI, GI, BOP, PPD, GR, CAL and BL)) showed a statistically significant difference between the study groups ($p < 0.001$), as shown in Table 3. From the group I to III, PI and GI were down. The lowest amount of BL (anterior and posterior) was observed in users of toothbrush and miswak, respectively ($p > 0.05$). The lowest CAL (both anterior and posterior) was recorded among miswak users ($p > 0.05$). Table 4 show the details of post hoc Bonferroni test results for comparing the periodontal variables between study groups. Subsequently, Pearson correlation (95 % CI) analysis was done between periodontal variables with the smoking habit (number of cigarettes and smoking) as shown in Table 5 and Table 6. It showed a positive correlation of GI (r = 0.753) and recession (r = 0.436) ($p < 0.001$) for the number of cigarettes smoked in group I, and anterior PPD (r = 0.388) ($p < 0.001$) for the duration of smoking (in years) in group III. There is also a negative correlation of BOP in group III or (r = - 0.339) ($p < 0.05$) for the frequency of

tooth cleaning and GI (r = - 0.381) ($p < 0.001$) in group II.

DISCUSSION

Smoking tobacco is a notable risk factor that causes and advancement of periodontal disease. It is also listed as the second major risk factor for global death and disability and is a significant health in Saudi Arabia [1]. Smoking prevalence varies from 2 to 52 percent across different strata of the Saudi Arabia population [11]. Diverse factors responsible for smoking adverse effects include enhanced oxidative stress, diminished antioxidant defenses, elevated inflammatory activity, and compromised tissue repair capacities [1]. It has been commonly observed that smokers have a substantially higher plaque index than non- smokers, an average amount of bleeding on probing [12]. However, as far as we know, this is the first study that disclose the periodontal status in smokers among miswak users as an oral hygiene method.

Table 3: Comparative analysis of periodontal variables between study groups

Variable	Group I (n=50)	Group II (n=50)	Group III (n=50)	*P*-value
	Mean ± SD	Mean ± SD	Mean ± SD	
PI	2.29 ± 0.41	1.64 ± 0.52	1.38 ± 0.37	0.000*
GI	2.22 ± 0.31	1.78 ± 0.53	1.57 ± 0.44	0.000*
BOP	90.00 ± 15.15	85.00 ± 17.49	79.50 ± 27.05	0.041*
PPD Anterior	3.80 ± 1.28	3.01 ± 0.64	2.87 ± 0.75	0.000*
Rec Anterior	3.20 ± 0.67	2.50 ± 0.97	2.34 ± 1.19	0.000*
CAL Anterior	6.21 ± 0.51	6.14 ± 2.03	5.37 ± 1.28	0.006*
PPD Posterior	4.03 ± 1.18	3.13 ± 0.72	3.28 ± 0.55	0.000*
Rec Posterior	3.18 ± 0.63	2.44± 0.90	2.34 ± 1.19	0.000*
CAL Posterior	6.46 ± 0.62	6.37 ± 1.84	5.57 ± 1.22	0.001*
BL Anterior	2.56 ± 0.58	2.16 ± 1.67	1.92 ± 1.14	0.030*
BL Posterior	3.59 ± 2.13	2.89 ± 1.66	2.55 ± 1.68	0.018*

PI: plaque index; GI: gingival index; BOP: bleeding on probing; PPD: probing pocket depth; Rec: recession; CAL: clinical attachment level; BL: bone loss; ns: not significant; *$p < 0.05$; significant; **$p < 0.001$; highly significant; SD: standard deviation

Table 4: Post hoc Bonferroni test results for comparative analysis of different periodontal variables between study groups

Variable	Group I vs II		Group I vs III		Group II vs III	
	Mean difference	*P-value*	*Mean difference*	*P-value*	*Mean difference*	*P-value*
PI	0.655	0.000*	0.917	0.000*	0.262	0.010*
GI	0.439	0.000*	0.651	0.000*	0.211	0.052 ns
BOP	5.000	0.678ns	10.500	0.035*	5.500	0.549 ns
PPD anterior	0.795	0.000*	0.930	0.000*	0.135	1.00 ns
Rec anterior	0.700	0.001*	0.860	0.000*	0.160	1.00 ns
CAL anterior	0.065	1.00 ns	0.835	0.011*	0.770	0.022*
PPD posterior	0.901	0.000*	0.751	0.000*	0.150	1.00 ns
Rec posterior	0.740	0.000*	0.840	0.000*	0.100	1.00 ns
CAL posterior	0.088	1.00 ns	0.890	0.003*	0.801	0.009*
BL anterior	0.403	0.298 ns	0.646	0.026*	0.243	0.956 ns
BL posterior	0.696	0.180 ns	1.037	0.016*	0.341	1.00 ns

PI: plaque index; GI: gingival index; BOP: bleeding on probing; PPD: probing pocket depth; Rec: recession; CAL: clinical attachment level; BL: bone loss; ns: not significant; *$p < 0.05$; significant; **$p < 0.001$; highly significant; SD: standard deviation

Table 5: Correlational analysis of periodontal variables with smoking habit

Parameter	Variable	Group I		Group II		Group III	
		r	*P*-value	r	*P*-value	r	*P*-value
No. of cigarettes smoked	Plaque Index	0.219	0.126ns	-0.084	0.563 ns	0.074	0.612 ns
	Gingival Index	0.753	0.000**	-0.101	0.483 ns	0.092	0.525 ns
	BOP	0.346	0.014*	0.023	0.876 ns	0.019	0.897 ns
	PPD Anterior	0.107	0.458 ns	-0.076	0.599 ns	0.191	0.185 ns
	Rec Anterior	0.357	0.011*	-0.102	0.482 ns	0.178	0.215 ns
	CAL Anterior	-0.165	0.252 ns	0.256	0.073 ns	0.271	0.057 ns
	PPD Posterior	0.059	0.682 ns	-0.405	0.004**	-0.025	0.864 ns
	Rec Posterior	0.436	0.002**	0.019	0.895 ns	0.178	0.215 ns
	CAL Posterior	0.338	0.016*	0.035	0.81 ns	0.184	0.201 ns
	BL Anterior	-0.287	0.044*	0.043	0.767 ns	-0.082	0.573 ns
	BL Posterior	-0.204	0.154 ns	0.132	0.36 ns	-0.029	0.84 ns
Duration of smoking (number of years)	Plaque Index	0.161	0.263 ns	0.216	0.131 ns	0.266	0.062 ns
	Gingival Index	0.022	0.879 ns	0.218	0.128 ns	0.119	0.41 ns
	BOP	0.134	0.355 ns	0.082	0.57 ns	-0.171	0.234 ns
	PPD Anterior	0.087	0.546 ns	0.111	0.443 ns	0.388	0.005**
	Rec Anterior	0.142	0.325 ns	-0.04	0.784 ns	0.052	0.722 ns
	CAL Anterior	0.042	0.772 ns	0.356	0.011*	0.328	0.02*
	PPD Posterior	-0.092	0.526 ns	-0.024	0.867 ns	-0.162	0.261 ns
	Rec Posterior	0.097	0.501 ns	-0.035	0.81 ns	0.052	0.722 ns
	CAL Posterior	0.252	0.077 ns	0.262	0.066 ns	0.280	0.049*
	B L Anterior	-0.297	0.036*	0.356	0.011*	0.062	0.667 ns
	BL Posterior	-0.327	0.02*	0.307	0.03*	0.224	0.117 ns

PI: plaque index; GI: gingival index; BOP: bleeding on probing; PPD: probing pocket depth; Rec: recession; CAL: clinical attachment level; BL: bone loss; ns: not significant; *p<0.05; significant; **p<0.001; highly significant; SD: standard deviation

Table 6: Correlation Analysis of periodontal variables with tooth cleansing habit

Parameter	Variable	Group I		Group II		Group III	
		r value	*P*-value	r value	*P*-value	r value	*P*-value
Frequency	PI	-	-	-0.015	0.916 ns	0.099	0.493 ns
	GI	-	-	-0.07	0.629 ns	0.099	0.494 ns
	BOP	-	-	0.115	0.425 ns	-0.339	0.016*
	PPD Anterior	-	-	0.242	0.09 ns	-0.037	0.8 ns
	Rec Anterior	-	-	-0.141	0.33 ns	0.037	0.797 ns
	CAL Anterior	-	-	0.107	0.459 ns	0.005	0.973 ns
	PPD Posterior	-	-	0.049	0.736 ns	0.179	0.213 ns
	Rec Posterior	-	-	0.038	0.791 ns	0.102	0.48 ns
	CAL Posterior	-	-	-0.091	0.531 ns	0.113	0.434 ns
	BL Anterior	-	-	-0.049	0.736 ns	-0.028	0.85 ns
	BL Posterior	-	-	0.122	0.399 ns	-0.175	0.224 ns
Time taken	PI	-	-	-0.272	0.056 ns	-0.202	0.159 ns
	GI	-	-	-0.381	0.006**	-0.146	0.312 ns
	BOP	-	-	0.06	0.681 ns	-0.113	0.434 ns
	PPD Anterior	-	-	0.16	0.266 ns	0.08	0.579 ns
	Rec Anterior	-	-	0.046	0.75 ns	0.087	0.548 ns
	CAL Anterior	-	-	0.036	0.806 ns	0.014	0.922 ns
	PPD Posterior	-	-	0.271	0.057 ns	-0.126	0.384 ns
	Rec Posterior	-	-	-0.029	0.84 ns	-0.045	0.758 ns
	CAL Posterior	-	-	0.053	0.716 ns	0.006	0.967 ns
	BL Anterior	-	-	0.156	0.278 ns	-0.185	0.197 ns
	BL Posterior	-	-	0.539	0.000**	-0.063	0.663 ns

PI: plaque index; GI: gingival index; BOP: bleeding on probing; PPD: probing pocket depth; Rec: recession; CAL: clinical attachment level; BL: bone loss; ns: not significant; *p < 0.05; Significant; **p < 0.001; highly significant

Since oral hygiene practices differ from person to person, significant differences were also observed between smokers and non-smokers, too, regarding oral hygiene practices [13]. These are close to our study finding in which most participants cleaned their teeth using toothbrush once a day (46.5 percent). We could not find any research comparing periodontal disease incidence among smokers using different types of oral hygiene aids. Research directed at oral health status as perceived by smokers and non-smokers in England showed revealed more significant oral hygiene deficiency among smokers [14]. A similar pattern was seen in our

group II sample, where most of them remembered that they had only been brushing for about one minute. Miswak users showed a successful two-minute oral hygiene method of brushing. The same subjects were performed in both classes regardless of the time required for brushing, up and down movement.

Multiple cross-sectional and longitudinal studies have widely identified the adverse effects of smoking on the periodontium. Increased pocket depth measurements, attachment loss, and alveolar bone loss are more prevalent in smokers than non-smokers [15]. The number of cigarettes used per day was in group III (11.52 ± 6.37), and in group II (9.90 ± 2.57) was lowest. Similarly, group II reported the longest time of smoking cigarettes, while it was shortest for group III (p = 0.248).

It is probably not the number of cigarettes, but the harmful chemicals it releases because smoking even a couple of cigarettes a day increases the risk of ischemic disease and lung cancer to a larger extend [16]. Hence, even light smokers have the possibility of encountering health issues. Another study showed median life expectancy was shorter by almost ten years for lifelong non-daily smokers than never smokers [17].

The lower PI and GI (indicative of oral hygiene status) seen in miswak users than users of the toothbrush indicate the protective function of miswak exerts. Different studies indicate substantial improvement in plaque score and gingival health using Miswak as an alternative to tooth brushing [18]. The practice of brushing twice daily with miswak has been found to produce a notable reduction in gingivitis in the buccal aspect when compared with tooth brushing. However, there was only a minor improvement in the lingual aspect [18]. Not only is there improvement in the oral hygiene status, but also a reduction in the levels of subgingival microbiota such as *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* has been found [19]. This could be due to the release of benzyl isothiocyanate (BITC) [19].

A few randomized trials show that users of miswak demonstrate an improved mean gingival score and a substantial decrease in the bleeding index (BI) following the use of *S. persica* extract chewing gum [20]. This change may be due to the properties of antimicrobial in *S. persica* [21]. The miswak users had less recession in terms of gingival recession than other participants. Similar findings were found in an earlier study while other mentions miswak had scrubbed too much of the tooth surfaces and induced gingival recession [22].

A favourable oral hygiene index score but higher gingival recession scores in miswak (*S. persica*) may influence periodontal health [22]. The prevalence and magnitude of gingival recession in miswak and toothbrush users are very similar. However, it has been attributed as a reason for the increased occlusal tooth wear in Saudi Arabia's young adults, along with other factors such as bruxism, pen, and nail-biting habits and high consumption of fruit juices [23].

Strengths and limitations of this study

Though some previous studies have compared smokers and non-smokers, this is the first research documenting the periodontal status of smokers who are exclusive miswak users for oral hygiene maintenance. Furthermore, there are no reports so far evaluating various oral hygiene practices among smokers from most parts of this country. Tooth loss is often considered a direct result of smoking, but this criterion could not be included in the assessment as most participants could not remember the cause of extraction correctly (periodontitis or caries) [2]. In this area, caries are also found to be the leading cause of extraction [23]. While Miswak showed improvement in some periodontal parameters, there are few disadvantages associated. Although similar in function, miswak, and toothbrushes have designs that vary. The bristles of the miswak are located along the long axis of its handle. This could make lingual and interdental aspects inaccessible while toothbrush permits easy access even in the posterior teeth distal tooth surfaces.

The World Health Organization has advocated the use of these herbal tools for oral hygiene and is in line with the principles of the Primary Health Care Approach. Miswak is recommended as an alternative to the toothbrush for optimum oral health and hygiene, but attaining its optimum effects depends on its routine use with proper and efficient techniques. Though miswak has oral health benefits in smokers, its use should be further studied in conjunction with daily toothbrushing and oral hygiene treatment. Due to its antimicrobial, antioxidant, anticonvulsant, sedative, analgesic and anti-inflammatory activity, miswak with an alternative nicotine source is also recommended for patients on a smoking cessation program [24].

CONCLUSION

Within the limitations of this study, it can be noted that the incidence of periodontal damage among adult current smokers is lower in exclusive miswak users than in exclusive toothbrush users. Besides, because of its excellent mechanical plaque-removing efficiency and a wide variety of therapeutic properties, miswak may be considered an effective oral hygiene tool for smokers.

DECLARATIONS

Acknowledgement

Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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