Periodontal status of adult Sudanese habitual users of miswak chewing sticks or toothbrushes

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Miswak chewing sticks are prepared from the roots or twigs of *Salvadora persica* plants. They are widely used as a traditional oral hygiene tool in several African and Middle Eastern countries. The aim of this study was to assess and compare the periodontal status of adult Sudanese habitual miswak and toothbrush users. The study population comprised male miswak users ($n = 109$) and toothbrush users ($n = 104$) with age range 20–65 years (mean 36.6 years) having 18 or more teeth present. They were recruited among employees and students at the Medical Sciences Campus in Khartoum, Sudan. One examiner used the Community Periodontal Index (CPI) to score gingival bleeding, supragingival dental calculus, and probing pocket depth of the index teeth of each sextant. In addition, the attachment level was measured, which, along with the CPI, was used to assess the periodontal status of the two test groups. Gingival bleeding and dental calculus were highly prevalent in the study population. Approximately 10% of the subjects had $\geq$4 mm probing depth and 51% had $\geq$4 mm attachment loss in one or more sextants. Subjects in the age group 40–65 years had a significantly ($p < 0.05$) higher number of sextants with gingival bleeding and with $\geq$4 mm probing depth and attachment loss than the 30–39 years group. Miswak users had significantly ($p < 0.05$) lower dental calculus and $\geq$4 mm probing depth and higher $\geq$4 mm attachment loss as well as a tendency ($p = 0.09$) to lower gingival bleeding in the posterior sextants than did toothbrush users. These differences were not significant in the anterior sextants. It is concluded that the periodontal status of miswak users in this Sudanese population is better than that of toothbrush users, suggesting that the efficacy of miswak use for oral hygiene in this group is comparable or slightly better than a toothbrush. Given the availability and low cost of miswak, it should be recommended for use in motivated persons in developing countries. ☐ *Gingivitis; miswak; oral hygiene; periodontal disease/epidemiology; Salvadora persica; traditional medicine*

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In several countries in the Middle East, Asia, and Africa, the tradition of using certain plants as chewing sticks for oral hygiene purposes is widely practiced and has deep cultural and often religious roots (1, 2). A recent national health survey in Pakistan showed that more than half of the rural population there used chewing sticks as an oral hygiene tool (3). Sticks from these plants are usually chewed on one end until they become frayed into a brush-like form, which is then used to clean the teeth in a similar manner to a toothbrush. It is claimed that the mechanical plaque-removing properties of chewing sticks may be similar to that of a conventional toothbrush (4, 5).

Miswak (also called meswak, misswak, or mswaki) is a chewing stick prepared from the roots or twigs of *Salvadora persica* (6), and it is widely used in Middle Eastern and Eastern African cultures. It has been shown that the *S. persica* plant and other related plants have chemical constituents with various biological properties, including significant antibacterial (7–9) and antifungal effects (10). It has also been demonstrated that extracts from these plants may be effective against some putative periodontal pathogens and other bacteria that are important during development of dental plaque (11, 12). It has therefore been proposed that these chewing sticks have antiplaque effects and postulated that they may also affect the pathogenesis of periodontal diseases by reducing the virulence of periodontopathic bacteria (13).

Results from epidemiological studies suggest that the periodontal treatment need is low in habitual miswak users (14). One study comparing the effectiveness of using miswak or toothbrush concluded that when miswak is used 5 times a day it might offer a suitable alternative to a toothbrush for reducing plaque and gingivitis (15). Furthermore, miswak was considered insufficient for maintaining interproximal oral hygiene when used without additional interdental oral hygiene aids. However, there are no reliable epidemiological data that document the beneficial effects of miswak on a population base.

In Sudan, oral and dental cleaning with miswak has been practiced since ancient times (1). Despite the availability of modern oral hygiene methods, the use of miswak is still popular in urban and rural areas, particularly among males. There are no published data about the oral and periodontal health of adult Sudanese

habitual miswak users. This study was therefore undertaken to assess and compare the periodontal status of adult male Sudanese habitual miswak and toothbrush users.

Materials and method

Study population

A total of 213 male subjects aged between 20 and 65 years (mean 36.6 years) participated in this study. They comprised employees and students at the Faculty of Medical Sciences, University of Khartoum, Sudan who volunteered to participate in the study. Information about the aim and other aspects of the study was distributed through placards on bulletin boards in cafeterias and the local mosque on the university campus. The volunteers, subjected to a structured interview to assess their demographic profile and oral hygiene habits, comprised 109 and 104 regular miswak and toothbrush users, respectively. Regular miswak and toothbrush users were defined as individuals who reported using the specific oral hygiene method at least once a day for the past year. They were included in the study if they had 18 teeth or more present. They were in good general health and had not used antibiotics in the previous 3 months. Other inclusion criteria were no present or past history of smoking cigarettes or use of other tobacco products.

Periodontal examination

The presence of gingival bleeding, supragingival calculus, and increased probing depths was assessed by the Community Periodontal Index (CPI) (16) on 6 sextants per subject. In accordance with the CPI hierarchical system, each sextant was given one score as follows: score 4 = ≥6 mm probing depth; score 3 = 4–5 mm probing depth; score 2 = supragingival calculus; score 1 = gingival bleeding, and score 0 = healthy periodontium.

In each sextant, the index teeth qualifying the sextant for the examination or all the remaining teeth in that sextant, in the event there were no index teeth, were dried in air. The WHO TRS-621 C-version periodontal probe (17) was then inserted not more than 2 mm into the gingival sulcus and moved around the circumference of each tooth to assess gingival bleeding. Bleeding was scored after the sites of a single quadrant were probed. Supragingival calculus was defined as calcified deposits located on exposed crowns and root surfaces. The probing pocket depth was defined as the distance from the free gingival margin to the bottom of a pocket/sulcus. This distance was recorded in millimeters and was rounded to the lowest whole millimeter. Each sextant was given the highest score of examined teeth. Attachment loss was then assessed and defined as the distance from the cemento-enamel junction (CEJ) to the bottom of a pocket/sulcus. When the CEJ of a site could not be identified owing to the presence of a restoration, the apical margin of the restoration was used as a reference point. The following cut-off points for scoring attachment loss were used: 0–3 mm, 4–5 mm and ≥6 mm.

The examination was undertaken at the Dental Center of the University of Khartoum, Sudan and was carried out by one examiner (I.A.D) who had been calibrated at the Department of Periodontology, the Faculty of Dentistry, University of Bergen, Norway.

Data analysis

The assessments were used to calculate the percentage of subjects and the mean number of sextants per subject with gingival bleeding, calculus, and ≥4 mm and ≥6 mm probing depth and attachment loss. The analysis of variance for unbalanced data was used to compare the groups and the model adjusted for age group (20–39, 40–65 years); the testing was performed using the statistical package (SAS version 6.12 on a SUN computer). P-values <0.05 were considered statistically significant. Because of the low number of sextants with pockets and attachment loss ≥6 mm, these sextants were included in pockets and attachment loss ≥4 mm in some statistical analyses.

Results

Gingival bleeding

In this population, 54% of all participants had one or more sextants with gingival bleeding, and about half of these subjects (23% of total) had gingival bleeding in 3 or more sextants (Table 1). The number of sextants with gingival bleeding increased with the age of the subjects, and subjects in the age group 40–65 years showed significantly higher numbers of sextants with bleeding than the 20–39 years old group (Table 2). In addition, gingival bleeding was more frequent in maxillary than in mandibular sextants, and occurred more often in posterior than in anterior teeth (Table 3).

Supragingival calculus

Thirty-one-point-nine percent of the subjects scored positive for dental calculus, and most of these (24.9% of total) had only one sextant with calculus (Table 1). There was no significant correlation between the prevalence of calculus and the age of the subjects (Table 2). The mandibular anterior teeth had the highest prevalence of calculus (Table 3).

Probing pocket depth and attachment loss

Approximately 10% of the subjects had sites with ≥4 mm probing depth, and half of these subjects (4.7% of total) had two or more sextants with ≥4 mm probing

Table 1. Numbers and percentages of subjects by the number of sextants per subject with one or more periodontal variables

	No. (*n*) of sextants with a given periodontal variable									
	1		2		3		4–6		Total	
Variable	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gingival bleeding	23	10.8	43	20.2	33	15.5	16	7.5	115	54.0
Supragingival calculus	53	24.9	11	5.2	2	0.9	2	0.9	68	31.9
Probing depth ≥4 mm	11	5.2	7	3.3	2	0.9	1	0.5	21	9.9
Probing depth ≥6 mm	4	1.9							4	1.9
Attachment loss ≥4 mm	49	23.0	28	13.1	21	9.9	11	5.2	109	51.2
Attachment loss ≥6 mm	12	5.6	2	0.9	1	0.5	1	0.5	16	7.5

depth (Table 1). Attachment loss was much more prevalent in the study subjects, with 51.2% of all subjects having at least one sextant, and 28.2% subjects showing 2 or more sextants with ≥4 mm attachment loss. Only 1.9% and 7.5% of the subjects had ≥6 mm probing depth and attachment loss, respectively (Table 1). With the increase in age, the subjects showed a significant increase in the number of sextants with ≥4 mm probing depth and attachment loss (Table 2).

Miswak users versus toothbrush users

Analysis of the overall effect of the 2 oral hygiene methods showed no marked differences between the 2 methods on the periodontal variables assessed in this population (Table 4). However, the results did show a general tendency to a lower number of sextants with gingival bleeding, dental calculus, and ≥4 mm probing depth, and a higher number of sextants with ≥4 mm attachment loss in the miswak than in the toothbrush users. Further analysis showed notable differences by the type of sextant, with a seemingly different pattern for anterior than posterior sextants (Table 5). Hence, the variance analysis was done separately for these two types (Table 6). The results showed that miswak users had significantly lower numbers of posterior sextants with dental calculus ($p = 0.002$) and ≥4 mm probing depth ($p = 0.057$), and higher number of anterior sextants with dental calculus ($p = 0.4$) than toothbrush users.

Table 2. Mean numbers and standard error (S.E.) of sextants per subject with one or more periodontal variables, by age group

	Age group				
	20–39 years		40–65 years		
Periodontal variables	Mean	S.E.	Mean	S.E.	*p*-values
Gingival bleeding	1.09	0.12	1.69	0.16	0.004
Supragingival calculus	0.42	0.06	0.42	0.08	0.99
Probing depth ≥4 mm	0.10	0.05	0.28	0.06	0.03
Probing depth ≥6 mm	0.01	0.01	0.04	0.02	0.09
Attachment loss ≥4 mm	0.86	0.11	1.28	0.15	0.02
Attachment loss ≥6 mm	0.07	0.04	0.19	0.05	0.05

Discussion

In this study, we assessed the effect of miswak use in adult Sudanese subjects by comparing 4 periodontal parameters in habitual miswak and toothbrush users. Miswak users showed a tendency, although the differences were not statistically singnificant, towards a lower number of sextants with gingival bleeding, dental calculus, and ≥4 mm probing depth, as well as a higher number of sextants with ≥4 mm attachment loss than toothbrush users. The differences between miswak and toothbrush users were more significant when only posterior teeth were included in the analyses. These results suggest a beneficial and superior efficacy of miswak use in reducing the number of sextants with gingival inflammation and calculus than toothbrush use in posterior teeth.

The level of supragingival dental calculus is a fairly good measure of the oral hygiene level and the frequency of professional dental care in a population. Calculus promotes and retains dental plaque on its outer surface (18) and it is an important risk factor of progression of attachment loss (19).

Gingival recession was not assessed in this study. However, the lower level of probing depth and the tendency to show a higher level of attachment loss in miswak users than in toothbrush users suggest that the former group had a higher level of gingival recession than toothbrush users. It has been shown that use of miswak chewing sticks may contribute to a higher level of gingival recession (20, 21) and may also be associated with occlusal tooth wear (22). The sticks are usually implemented for 3 to 5 min several times a day, often on the buccal and occlusal surfaces of teeth. An optimal technique of miswak use has not been investigated.

In this study, the same examiner scored the oral hygiene

Table 3. Percentages of subjects scoring positive to one or more periodontal variables, by type of sextants assessed

	Sextants					
Periodontal variable	Maxillary right posterior	Maxillary anterior	Maxillary left posterior	Mandibular right posterior	Mandibular anterior	Mandibular left posterior
Gingival bleeding	31.0	15.0	32.4	20.2	13.6	17.8
Supragingival calculus	5.6	3.3	4.2	9.4	16.0	3.3
Probing depth ≥4 mm	7.0	1.4	4.7	2.3	0.5	0.5
Attachment loss ≥4 mm	25.4	19.2	14.1	9.9	25.8	6.6

habits and also assessed the periodontal status of the study groups. Hence, the identity of the groups was not concealed from the examiner. Furthermore, no more details were available about the oral hygiene habits beyond the frequency of miswak/toothbrush use. This could have contributed to a measurement bias.

In this population, 54% of subjects had gingival bleeding and 31.9% had supragingival dental calculus in one or more sextants. It should be noted, however, that these assessments were made using the CPI, i.e. a system in which a hierarchical and partial recording methodology is used. Accordingly, a tooth with calculus as the most severe finding may also be assumed positive for gingival bleeding, and a tooth with ≥4 mm probing depth can also be assumed positive for bleeding and calculus. Hence, the prevalence of gingival bleeding and calculus in the study group would be estimated markedly higher than the figures cited above. Nevertheless, it should also be noted that the CPI system may inherently either underestimate or overestimate the prevalence and severity of periodontal parameters (23, 24). For this reason, direct comparison of the present findings for bleeding and calculus with findings of other epidemiologic studies is inadvisable.

Furthermore, 9.9% and 1.9% of the present subjects had one or more sites with ≥4 mm and ≥6 mm probing depth, and 51.2% and 7.5% subjects had one or more sites with ≥4 mm and ≥6 mm attachment loss, respectively. In a recent national survey of periodontal status of adults in the United States, Albandar et al. (25) reported a corresponding prevalence in African-American adults of 20.16% and 3.0% for probing depth, and 44.82% and 21.57% for attachment loss. This suggests that the Sudanese subjects studied by us had on average a higher prevalence of ≥4 mm attachment loss and a lower prevalence of probing depth and of ≥6 mm attachment loss than the African-American adults. One possible explanation for this difference may be a higher prevalence of gingival recession in the Sudanese population attributed to miswak use. In addition, the Sudanese group was relatively younger and had a higher number of teeth present.

Other studies evaluating the efficacy of miswak use have shown a significant reduction of dental plaque and gingivitis and a comparable or superior oral hygiene effect compared to toothbrushing (4, 15, 26). There is also evidence that miswak is more effective as an oral hygiene tool in buccal than lingual tooth surfaces (15). Olsson (27) assessed the oral hygiene efficacy in schoolchildren of a wooden chewing stick called mefaka that is used in Ethiopia. When used under supervision, the mefaka and the toothbrush showed similar oral hygiene effects. On the other hand, there are no valid population level data on the effects of using traditional oral hygiene means on periodontal health.

There has recently been renewed interest in the use of natural medicine for the promotion of general health (28, 29). Furthermore, the usefulness of traditional oral medicine in the control of oral diseases is gaining increasing interest, and clinical investigation of these indigenous means is emerging (15, 30). Other reasons that provoke interest in the study of miswak is its popularity, low cost, and habitual use as an oral hygiene tool in several developing countries. The use of miswak for oral hygiene has a long tradition in Middle Eastern and African countries, going back several centuries (1), and it is still common in these cultures (2–5)

In summary, the findings in our Sudanese population showed that the periodontal status of miswak users is better than that of toothbrush users, suggesting that the efficacy of miswak use for oral hygiene in this group is similar or slightly better than that of a toothbrush. Miswak is

Table 4. Mean numbers and standard error (S.E.) of sextants per subject with gingival bleeding, supragingival calculus, probing depth, and clinical attachment loss adjusted for age, by oral hygiene group

Variable	Oral hygiene group	Mean	S.E.	*p*-values
Gingival bleeding	Miswak	1.23	0.14	0.09
	Toothbrush	1.56	0.14	
Dental calculus	Miswak	0.33	0.07	0.07
	Toothbrush	0.51	0.07	
Probing depth ≥4 mm	Miswak	0.15	0.05	0.20
	Toothbrush	0.24	0.06	
Probing depth ≥6 mm	Miswak	0.02	0.01	0.90
	Toothbrush	0.02	0.01	
Attachment loss ≥4 mm	Miswak	1.17	0.12	0.30
	Toothbrush	0.97	0.13	
Attachment loss ≥6 mm	Miswak	0.10	0.04	0.40
	Toothbrush	0.16	0.04	

Table 5. Percentages of subjects scoring positive to one or more periodontal variables, distributed by oral hygiene group and type of sextants assessed

	Sextants					
Periodontal variable Oral hygiene group	Maxillary right posterior	Maxillary anterior	Maxillary left posterior	Mandibular right posterior	Mandibular anterior	Mandibular left posterior
Gingival bleeding						
Miswak	25.7	15.6	28.4	16.5	11.0	17.4
Toothbrush	36.5	14.4	36.5	24.0	16.4	18.3
Supragingival calculus						
Miswak	2.8	3.7	1.8	2.8	18.4	3.7
Toothbrush	8.7	2.9	6.7	16.4	13.5	2.9
Probing depth ≥4 mm						
Miswak	4.6	2.8	1.8	1.8	0.9	0.0
Toothbrush	9.6	0.0	7.7	2.9	0.0	1.0
Attachment loss ≥4 mm						
Miswak	26.6	21.1	11.0	14.7	29.4	8.3
Toothbrush	24.0	17.3	17.3	4.8	22.1	4.8

available, at low cost, and there is motivation for its use in several developing countries. Our findings, and the findings of others (14, 15), suggest significant health gains from using miswak as an oral hygiene tool. It is therefore suggested that miswak use in motivated persons should be encouraged. However, further studies are needed to evaluate the optimal frequency and method of use, and to study the efficacy of plaque removal in the interproximal areas.

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Table 6. The mean numbers and standard error (S.E.) of sextants per subject with gingival bleeding, supragingival calculus, probing depth, and clinical attachment loss adjusted for age, by oral hygiene group, and tooth type

Variables	Oral hygiene group	Mean	S.E.	*p*-values
Anterior teeth				
Gingival bleeding	Miswak	0.30	0.05	0.5
	Toothbrush	0.34	0.05	
Dental calculus	Miswak	0.22	0.04	0.4
	Toothbrush	0.17	0.04	
Probing depth ≥4 mm	Miswak	0.04	0.01	0.05
	Toothbrush	0.009	0.01	
Attachment loss ≥4 mm	Miswak	0.53	0.06	0.2
	Toothbrush	0.42	0.07	
Posterior teeth				
Gingival bleeding	Miswak	0.94	0.12	0.09
	Toothbrush	1.22	0.12	
Dental calculus	Miswak	0.11	0.05	0.002
	Toothbrush	0.35	0.06	
Probing depth ≥ 4 mm	Miswak	0.10	0.05	0.057
	Toothbrush	0.23	0.05	
Attachment loss ≥ 4 mm	Miswak	0.64	0.04	0.20
	Toothbrush	0.55	0.04	

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