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Relationship between betel quid additives and established periodontitis among Bangladeshi subjects

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Abstract

Aim: To determine the relationship between betel quid chewing additives and established periodontitis in Bangladeshi subjects.

Material and Methods: A total of 864 subjects participated in this study. Among them, 140 pairs of sex- and age-matched case subjects and control subjects were selected. A case was defined as a person who had at least two sites with a clinical attachment level (CAL) $\geqslant$ 6 mm and at least one site with probing depth (PD) $\geqslant$ 5 mm. Subjects who did not fulfill these criteria were considered as controls. Information on sociodemographic variables, psychological stress, dental health behaviour, smoking and betel quid chewing habits was obtained.

Results: Multiple logistic regression analysis showed that current betel quid chewers had greater probabilities of having established periodontal disease than did non-chewers (odds ratio = 3.97, $p < 0.05$). Mean PD, mean CAL, mean percentage of bleeding on probing and number of missing teeth were significantly higher in chewers of betel quid with tobacco and masala than in chewers of betel quid without such additives adjusting for age, sex, smoking habit, body mass index, dental visit pattern, stress and plaque index. Higher frequency and longer duration of betel quid chewing showed a significant relation to an increase in periodontal parameters.

Conclusion: The results indicate that betel quid additives might significantly enhance periodontitis in the population studied.

Key words: Bangladeshi subjects; betel quid; masala; periodontal disease; tobacco

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Betel quid chewing is a part of in many religious and cultural rituals of ethnic groups within the Indian subcontinent and has gained a degree of social acceptance (Bedi & Gilthorpe 1995). An estimated 200 million people chew betel quid habitually. The style of betel quid chewing varies not only between nations but also between communities and individuals. The habit is commonly termed ''pan chewing'' in Bangladesh. The main components are the leaf of *Piper betel* L. (pan), nut of *Areca catechu* L. (supari), lime (chuna) and extract of the wood of *Acacia catechu* (katha). Normally, lime, *Acacia catechu* L and *Areca catechu* extract are smeared on the betel leaf, which is then partially folded into a funnel shape. Once folded completely, the quid is placed in the mouth, usually in the cheek, and gently chewed or sucked for as long as is desired, sometimes even during sleep (Summers et al. 1994, Prabhu et al. 2001). The habitual chewer may keep a ''chew'' in his/her mouth from 15 to 30 min. (Mehta et al. 1955).

Conflict of interest and source of funding statement

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The results of many studies have revealed relationships of betel quid chewing with oral cancer and oral soft tissue lesions (Ahmed & Islam 1990, Ko et al. 1992, 1995, Yang et al. 2005, Thomas et al. 2007). However, only a few studies have shown the relationship between betel quid chewing and periodontal disease (Mehta et al. 1955, Choudhury et al. 2003, Chatrchaiwiwatana 2006). There

has been no such study in Bangladeshi people. In Bangladesh, betel quid chewers commonly add tobacco leaf and/or one of a wide variety of other compounds named masala, a complex of spices such as cardamom, ginger, clove and grated coconut, to the quid (Gupta & Ray 2004). Although the periodontal effects of such additives are not known, it is possible that such additives lead to a distinct profile of periodontal disease in betel chewers. As far as we know, no investigations have focused on associations between additives in betel quid chewing and periodontal disease.

This study was designed to determine whether the habit of betel quid chewing with additives is a contributing factor to the rise in the incidence of periodontal disease among Bangladeshi people. In addition, the dose–response effects (frequency and duration) of habitual betel quid chewing were examined.

Material and Methods

Ethics and informed consent

Before the start of the study, ethical approval was obtained from the Executive Committee of Dhaka Dental College and Hospital. The aims of the investigation and the nature of the study were fully explained to the subjects, who gave informed consent before participation.

Subject recruitment

A total of 864 subjects who received dental treatment at the periodontal clinic of Dhaka Dental College & Hospital, Dhaka, Bangladesh, participated in this study. Among them, 140 pairs of sex- and age ($\pm$ 3 years)-matched periodontal cases and controls were selected. A periodontal case (patients with ''established periodontitis'') was defined as subjects with two or more interproximal sites with a clinical attachment level (CAL) of 6 mm or greater and at least one additional site with a probing depth (PD) of 5 mm or greater. However, these conditions did not have to be present in the same site or tooth (Machtei et al. 1992, Solis et al. 2004). Subjects who did not fulfill criteria were considered as controls (periodontal ''healthy'').

Exclusion criteria

Subjects were excluded from the study if they were pregnant, or if they had cardiovascular disease, uncontrolled diabetes or if they were taking immunosuppressant drugs.

Questionnaire

The subjects completed a questionnaire with questions on the habit of betel quid chewing, educational level, height, weight, smoking, psychosocial stress, oral hygiene practices and dental visiting behaviour. Betel quid chewing status (current chewers, former chewers and non-chewers) was defined as follows: current chewers were subjects who were currently consuming betel quid, former chewers were subjects who reported that they had quit betel quid chewing and non-chewers were subjects who had never chewed betel quid. Consumption of betel quid was expressed as the number of units used per day (frequency) and the number of years of consumption (duration) (Croucher et al. 2002). Usage of additives (tobacco and/or masala) was also recorded.

History of smoking habit was categorized as current, former or never having smoked cigarettes. A questionnaire based on the life events scale was used to estimate stress (Solis et al. 2004, Akhter et al. 2005), and subjects were asked to indicate the extent (never, rarely, sometimes, often) to which they agree with a statement that had occurred during the past 12 months. Subjects' responses were coded as 0 = ''never or rarely'' (stress negative) or 1 = ''sometimes or frequently'' (stress positive). Questions on oral hygiene dealt with the frequency of tooth brushing. Dental attendance pattern was defined as ''regular'' if the subject had visited a dentist once/year or more on a regular basis for maintenance care, and dental attendance pattern was defined as ''irregular'' if the subject visited a dentist only for emergency dental treatment or had not visited a dentist within the past year (Dalla Vecchia et al. 2005). Body mass index (BMI) was calculated as body weight (kg) divided by height^2 (m^2). Subjects with incomplete records were excluded from the study.

Clinical measurements

All permanent fully erupted teeth, excluding third molars, were examined under artificial light with mouth mirrors and a manual periodontal probe. Periodontal status was examined at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual). PD were measured with the probe tip parallel to the long axis of the tooth and positioned interproximally as close as possible to the contact point. Measurements were made to the nearest millimetre and the lowest value was scored where doubt existed. CAL was recorded as the distance from the cemento-enamel junction (CEJ) to the base of the clinical pocket. This was calculated by measuring the distance from the CEJ to the gingival margin and subtracting this value from the PD measurement (regression recorded as a negative value) (Linden et al. 2007). Gingival bleeding on probing (BOP) was recorded as percentage positive sites of whole-mouth measures. The PD and CAL measurements were averaged for each subject. The presence of plaque was recorded according to the plaque index (PI) (Löe & Silness 1964). The number of missing teeth was also recorded.

Two experienced dentists (R. A. and J. A.) examined the periodontal status. The two examiners were trained to check the accuracy and reproducibility of the various clinical parameters using volunteer patients in the Faculty Hospital before and during the survey. There were also regular weekly meetings to ensure inter examiner consistency and reproducibility throughout the study period. Inter-examiner reliability was assessed through replicate examinations of 10 patients. κ values between the examiners were 0.79 and 0.83 for assessing PD and CAL.

Statistical analysis

Comparisons of demographic features (age, gender, BMI, educational level), smoking habit, betel quid chewing status, stress, oral hygiene behaviour, number of present teeth and dental visiting pattern between cases and controls were made using χ^2 and Mann–Whitney tests for categorical and continuous variables, respectively. Logistic regression was used to obtain adjusted odds ratios (ORs) and their 95% confidence interval (CI) for the presence of periodontitis in relation to betel quid use (classified as current chewer, former chewer and non-chewer).

The correlations of additives of betel quid (tobacco and/or masala) and the duration and frequency of betel quid chewing with periodontal disease were examined. The mean values of PD, CAL, BOP% and percentage of missing teeth (MT) were compared in different subgroups using one-way analysis of

Table 1. Demographic and socio-economic variables of the controls (healthy) and cases (established periodontitis)

Variables	Controls ($n = 140$)	Cases ($n = 140$)
Mean ± standard deviation		
Age	38.5 ± 11.5	38.4 ± 11.7
Plaque index^{+}	1.2 ± 0.5	1.8 ± 0.7
BMI^{+}	23.5 ± 2.7	26.6 ± 3.9
No. of present teeth^{+}	25.9 ± 1.9	23.8 ± 4.2
Distribution of subjects (%)		
Sex		
Male	70 (50.0)	70 (50.0)
Female	70 (50.0)	70 (50.0)
Betel quid chewing habit**		
Non-chewer	52 (37.1)	7 (5.0)
Former chewer	22 (15.7)	19 (13.6)
Current chewer	66 (47.1)	114 (81.4)
Education level**		
College/University	48 (34.3)	19 (13.6)
Elementary and high school	30 (21.4)	47 (33.6)
Incomplete elementary school	62 (44.3)	74 (52.9)
Smoking habit**		
Nonsmoker	73 (52.1)	39 (27.9)
Former smoker	19 (13.6)	21 (15.0)
Current smoker	48 (34.3)	80 (57.1)
Stress in the past 12 months**		
Low	80 (57.1)	26 (18.6)
High	60 (42.9)	114 (81.4)
Dental visiting pattern/year*		
Regular visits ($\geqslant 1$ year)	20 (14.3)	6 (4.3)
Irregular visits (<1 year)	120 (85.7)	134 (95.7)
Frequency of tooth cleaning**		
<1 time/day	102 (72.9)	126 (90.0)
$\geqslant 1$ time/day	38 (27.1)	14 (10.0)

Significant difference between the two groups.
$^{+}p<0.001$ by Mann–Whitney test; $^{*}p<0.01$ and $^{**}p<0.001$ by χ^2 test.
BMI, body mass index.

covariance along with Bonferroni's post hoc adjusting for age, sex, smoking habit, BMI, dental visit pattern, stress and plaque index. The mean values of all clinical parameters were also compared among the subset of non-smokers ($n = 112$) in the same way.

The data were analysed using the SPSS software package (SPSS Inc., version 15.0 Family, Chicago, IL., USA). Probability levels at $p<0.05$ were considered to be statistically significant.

Results

One hundred and forty pairs of sex- and age (± 3 years)-matched cases (established periodontitis) and controls (healthy) were selected. Among them, 59 subjects (21.1%) had never chewed betel quid (non-chewers), 41 subjects (14.6%) had chewed betel quid previously (former chewers) and 180 subjects (64.3%) chewed betel quid everyday (current chewers).

Table 1 shows the demographic and clinical variables of the controls and cases. The number of current betel quid chewers was significantly larger in the case group than in the control group ($p<0.001$). Regarding educational level, a larger proportion of subjects with incomplete elementary education was observed in the case group ($p<0.001$). The mean BMI ($p<0.001$) and PI ($p<0.001$) was significantly greater in the case group than in the control group. There were significant associations of number of present tooth ($p<0.001$), smoking habit ($p<0.001$), high stress ($p<0.001$), frequency of cleaning <1 time/day ($p<0.001$) and irregular visits to dentists ($p<0.01$) with the severity of periodontal disease.

The results of multiple logistic regression analysis showed significant differences between the case and control groups in betel quid chewing status (current chewer, OR = 3.971, $p<0.05$) after controlling for other confounding factors (Table 2). Higher BMI (OR = 1.239, $p<0.001$), lower number of present teeth (OR = 0.842, $p<0.05$), higher PI (OR = 5.821, $p<0.001$) current smokers (OR = 4.201, $p<0.001$), high stress (OR = 5.172, $p<0.001$) and irregular dental visits (OR = 4.144, $p<0.05$) were also significantly associated with the presence of established periodontitis.

Associations of betel quid additives and the frequency and duration of betel quid chewing with periodontal disease were examined by comparing the mean scores of clinical parameters among subgroups adjusting for age, sex, smoking habit, BMI, dental visit pattern, stress and PI (Table 3). Chewers of betel quid with tobacco and masala showed significantly higher scores of BOP%, PD, CAL and MT% than those of chewers of betel quid without any additives. All the clinical parameters examined in the chewers of betel quid with tobacco and masala were also significantly higher than those in chewers of betel quid with tobacco only. All clinical scores of chewers of betel quid without any additives were not significantly different from those of chewers of betel quid with masala. However, the mean values of PD and CAL were significantly higher in chewers who uses tobacco leaf only than in chewers of betel quid without additives. Subjects with frequency of betel quid intake >10 times/day had significantly higher mean values of PD and CAL than those in subjects with an intake frequency of 6–10 times/day and in subjects with an intake frequency of 1–5 times/day. The mean BOP% of chewers with an intake frequency of 6–10 times/day was significantly greater than that in chewers with an intake frequency of 1–5 times/day. Subjects who had chewed betel quid for >3 years showed significantly higher scores of BOP%, PD and MT% than those of subjects who had chewed for <1 year. The mean BOP% and mean PD of subjects who had chewed for 1–3 years were significantly higher than those of subjects who had chewed for <1 year.

The associations of betel quid additives and the frequency and duration of betel quid chewing with periodontal disease were also examined among the subset of non-smokers (Table 4). The associations were similar to those found in the total subjects (Table 3).

Discussion

Epidemiological studies have clearly shown an association of betel quid

chewing habit with an increased risk of oral cancer and oral submucous fibrosis in India and Southeast Asian countries (Ko et al. 1992, 1995, Reichart et al. 1996). Recent studies have also shown a significant relationship between the presence of periodontitis and betel quid chewing habit in Taiwan (Jeng et al. 1996), Sri Lanka (Amarasena et al. 2002, 2003), Thailand (Chatrchaiwiwatana 2006, 2007) and India (Mehta et al. 1955, Choudhury et al. 2003). The results of the present study conducted in Bangladesh support the results of those studies. Choudhury et al. (2003) reported that betel quid chewing leads to poorer periodontal health as a result of the presence of *Heliobacter pylori* among dyspeptic subjects. Mehta et al. (1955) reported that teeth become dark brown from chewing betel leaves because of deposits of lime on teeth. The deposits become thick, encompass the entire tooth and are associated with loss of attachment and tooth mobility. Another possible reason for the harmful effect of betel quid, on periodontal health is the cholinergic effect of betel quid together with calcium salt in the saliva (''hypersalivation caused calculus deposition''). The increased heavy deposition of calculus then destroys gingival tissue and periodontal attachment in habitual betel quid chewers (Chatrchaiwiwatana 2006). Additionally, arecoline (a main alkaloid found in areca nut) has been shown to inhibit cell attachment, cell spreading and cell migration and to decrease cell growth and collagen synthesis in human-cultured periodontal fibroblasts (Chang et al. 1998, Trivedy et al. 2002). However, those reports did not provide any information about the detrimental effect of betel quid additives (tobacco leaf and masala) on the periodontal health of betel quid chewers.

Chewers of betel quid with tobacco and masala showed higher mean values of periodontal parameters, including mean PD, CAL, MT% and percentage of sites with BOP% than did chewers of betel quid without any additives (Table 3). The mean values of PD and CAL were significantly higher in chewers who used tobacco leaf only than in chewers of betel quid without additives. Chewing betel quid combined with tobacco is a culture-specific habit unique to south Asians, including Bangladeshis, and constitutes more or less the only form of smokeless tobacco used in that part of the world (World Health Organization 1988). Because

Table 2. Results of multiple regression analysis

Variables	95% Confidence limit		
	odds ratio	lower	upper
Body mass index (BMI)	1.239**	1.091	1.408
Plaque index	5.821**	2.910	11.642
No. of present teeth	0.842*	0.721	0.983
Education level			
College/University	1		
Elementary and high school	1.179	0.405	3.435
Incomplete elementary school	0.996	0.380	2.611
Betel quid chewing habit			
Non-chewer	1		
Former chewer	1.595	0.354	7.182
Current chewer	3.971*	1.186	13.296
Smoking habit			
Non-smoker	1		
Former smoker	2.915	0.872	9.740
Current smoker	4.201**	1.800	9.805
Stress in the past 12 months			
Low	1		
High	5.172**	2.481	10.777
Dental visiting pattern/year			
Regular visits	1		
Irregular visits	4.144*	1.092	15.730
Frequency of tooth cleaning			
<1 time/day	1		
$\geqslant 1$ time/day	0.781	0.272	2.242

*$p<0.05$ and **$p<0.001$, significant correlation.

Table 3. Comparison of betel quid ingredients, betel quid intake frequency/day and duration of betel quid intake/year according to the status of the subject's BOP, PD, CAL, percentage of missing teeth

Variables	No. of subjects	Bleeding on probing (%)	Probing depth	Clinical attachment level	Missing teeth (%)
Betel quid non-chewer	59	20.8 ± 10.4*	3.0 ± 0.6	1.5 ± 0.7	6.2 ± 7.2
Betel quid additives					
No additives	94	41.8 ± 16.6	3.8 ± 0.7	2.2 ± 0.9	6.4 ± 8.6
Masala	10	42.0 ± 16.3	3.9 ± 0.7	2.4 ± 0.7	8.8 ± 8.6
Tobacco	78	47.4 ± 19.6	4.7 ± 1.0[a]	2.8 ± 1.1[a]	11.8 ± 13.8
Tobacco and masala	39	62.5 ± 20.7[a, c]	6.4 ± 1.2[a, b, c]	4.2 ± 1.2[a, b, c]	18.4 ± 15.9[a, c]
Frequency of betel quid intake/day					
1–5 times/day	95	35.3 ± 15.9	4.1 ± 1.1	2.3 ± 1.0	8.0 ± 11.0
6–10 times/day	43	52.8 ± 17.6[d]	4.5 ± 1.2	2.5 ± 0.9	8.2 ± 7.8
>10 times/day	83	58.6 ± 16.9[d]	5.3 ± 1.3[d, e]	3.5 ± 1.3[d, e]	14.6 ± 15.5
Duration of betel quid intake					
<1 year	56	31.5 ± 11.1	3.7 ± 0.8	2.2 ± 0.9	5.6 ± 5.8
1–3 years	22	41.5 ± 17.6[f]	4.6 ± 1.2[f]	2.5 ± 0.8	6.0 ± 9.3
>3 years	143	54.6 ± 18.9[f, g]	4.9 ± 1.3[f]	3.0 ± 1.3	13.1 ± 14.4[f]

*Mean ± standard deviation.
Significantly greater than ''no additives'' (a), ''with masala'' (b) and ''with tobacco'' (c).
Significantly greater than ''1–5 times/day'' (d) and ''6–10 times per day'' (e).
Significantly greater than ''<1 year'' (f) and ''1–3 years'' (g).

Table 4. Comparison of betel quid ingredients, betel quid intake frequency/day and duration of betel quid intake/year according to the status of the non-smoker's BOP, PD, CAL, percentage of missing teeth

Variables	No. of non-smoker subjects	Bleeding on probing (%)	Probing depth	Clinical attachment level	Missing teeth (%)
Betel quid non-chewer	22	17.2 ± 10.0*	2.9 ± 0.3	1.3 ± 0.4	5.5 ± 6.9
Betel quid additives					
No additives	47	37.4 ± 14.9	3.7 ± 0.7	2.1 ± 0.9	5.7 ± 6.2
Masala	5	48.4 ± 21.3	3.9 ± 0.6	2.3 ± 0.7	11.2 ± 10.8
Tobacco	25	49.7 ± 20.2[a]	4.4 ± 0.8[a]	2.5 ± 1.1	8.2 ± 7.4
Tobacco and masala	13	71.5 ± 19.7[a, c]	6.8 ± 1.1[a, b, c]	4.9 ± 1.4[a, b, c]	12.7 ± 6.7[a]
Frequency of betel quid intake/day					
1–5 times/day	44	33.5 ± 13.3	3.8 ± 0.6	2.0 ± 0.6	5.7 ± 7.6
6–10 times/day	17	44.2 ± 12.9	4.1 ± 1.1	2.1 ± 0.8	8.1 ± 4.7
> 10 times/day	29	67.1 ± 17.5[d, e]	5.4 ± 1.6[d, e]	3.8 ± 1.8[d, e]	10.6 ± 7.2[d]
Duration of betel quid intake					
< 1 year	31	31.5 ± 8.8	3.7 ± 0.5	1.9 ± 0.4	4.0 ± 4.7
1–3 years	13	43.6 ± 18.4	4.6 ± 1.3	2.6 ± 0.9	7.5 ± 11.0
> 3 years	46	57.1 ± 21.1[f]	4.7 ± 1.5[f]	3.1 ± 1.7[f]	10.3 ± 6.3[f]

*Mean ± standard deviation.
Significantly greater than ''no additives'' (a), ''with masala'' (b), and ''with tobacco'' (c).
Significantly greater than ''1–5 times/day'' (d) and ''6–10 times/day'' (e).
Significantly greater than ''< 1 year'' (f).

tobacco has a harmful effect on periodontal health, the results are reasonable. One of the biological effects of tobacco chewing is vasoconstriction of the gingival vasculature, thereby impairing the gingival blood flow. Impaired gingival blood flow suppresses the normal gingival inflammatory response to plaque infection and consequently conceals the actual levels of gingival inflammation in smokers (Bergstrom & Preber 1994, Amarasena et al. 2003).

Masala is a commercially available product containing cardamom, grated fresh coconut, cloves, ginger and some sweetners. All the clinical parameters examined in chewers of betel quid with tobacco and masala were significantly higher than those in chewers of betel quid with tobacco only. However, there were no significant differences in the clinical parameters between chewers of betel quid without any additives and chewers of betel quid with masala only. Therefore, masala, despite the fact that it has little direct effect on periodontal health, might synergistically enhance the detrimental effect of tobacco leaf on periodontal disease progression. Recently, it has been found that masala has mutagenic properties (Trivedy et al. 2002). Although the mechanism remains unclear, it is possible that interactive and/or additional effects of these different additives affect periodontal health. Because there were few subjects who used masala only, the results from a larger number of subjects might reveal the direct effect of masala.

Reichart et al. (1996) found a strong correlation between the duration and frequency of betel quid used per day and the presence of oral mucosal lesions in elderly Cambodian women. However, they did not examine periodontal status. In the present study, the periodontal parameters became higher according to both the increase in the frequency and the duration of betel quid intake in the total participants (Table 3). Smoking is a confounder in this database and may be an effect modifier (Hyman 2006), that is why we analysed periodontal clinical parameters among the subset of non-smokers. As a result, we found similar results (Table 4). Significant associations of betel quid additives with established periodontal disease and dose–response effects (frequency and duration) of betel quid chewing were reconfirmed.

BMI was significantly associated with periodontitis, as was found in the previous studies (Saito et al. 1998, Dalla Vecchia et al. 2005, Bouchard et al. 2006, Linden et al. 2007). From an epidemiological viewpoint, it is noteworthy that studies conducted in developing countries, including Bangladesh, showed results similar to those of studies conducted in developed countries. In addition, the results of the present study agree with the results of past epidemiological studies that have shown a higher prevalence and severity of periodontal disease among individuals of irregular dental visits (Susin et al. 2004, Akhter et al. 2005, Fisher et al. 2005). The possibility of stress, a factor in the progression of periodontitis, was also supported by the results of other studies (Linden et al. 1996, Akhter et al. 2005, Castro et al. 2006).

There were some methodological limitations in the present study that should be considered when interpreting the results. First, it is not possible to draw strong conclusions over significant correlations between betel quid chewing habit and periodontal disease in such a cross-sectional study. However, the finding of dose–response effects supports the possibility of a causal relationship between betel quid chewing and periodontal disease. Second, several other factors that have been shown to be associated with periodontal disease status, including blood chemistry variables (cholesterol, blood glucose, etc.) and the profile of microorganisms, were not examined in this study.

In conclusion, the present cross-sectional study indicates that betel quid additives are positively associated with established periodontal disease. The dose–response effects (frequency and duration) of betel quid chewing were also observed. It is important to raise awareness of the periodontal risks among these populations. These practices have deep-seated cultural roots, and educational initiatives must be sensitive to the community's belief systems (Summers et al. 1994, Chen & Shaw 1996). Longitudinal community-based studies are needed to confirm these findings. In addition, new avenues of research should include qualitative assessment of attitudes to betel quid additives and betel quid

chewing, and effective ways to inform those concerned about its possible health consequences.

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Clinical Relevance

Scientific rationale for the study: Very few studies have shown the correlation of betel quid chewing with periodontal disease. There have been no studies on betel quid additives (tobacco leaf and masala) as possible risk indicators for periodontitis.

Principal findings: Significant associations were found between betel quid additives and periodontal clinical parameters. Higher frequency and long duration of betel quid chewing were significant predictors of established periodontitis.

Practical implications: Dentists in this community need to inform people about the harmful effect of betel quid additives as well as the harmful effect of betel quid chewing on periodontal health. Pending confirmation in larger community-based studies, the findings of this study may provide guidance for planning public health programmes to reduce the habit of betel quid chewing.