Periodontal Health Status in Pan Chewers With or Without the use of Tobacco

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Background: Betel nut and tobacco chewing is a common practice in south-east Asia. In India, betel nut is commonly chewed in the form of pan, with or without tobacco. Numerous studies have shown the carcinogenic potential of betel nut and tobacco. Betel nut and tobacco are also known to have deleterious effects on the oral tissues.

Purpose: The aim of our study was to evaluate and compare the periodontal effects of pan chewing with or without the use of tobacco as an ingredient.

Materials and Methods: The periodontal status of 300 subjects (150 subjects were pan chewers with tobacco and 150 subjects were pan chewers without tobacco) was evaluated using the community periodontal index (CPI). The subjects were selected by the stratified random sampling method. The oral hygiene status of the subjects was evaluated using the simplified oral hygiene index.

Results: CPI code-4, with a probing depth of 6 mm or more, was seen in 30% of pan chewers with tobacco compared with 7.3% of pan chewers without tobacco. It was found that pan chewers with tobacco had 4.7 times more risk of having pockets than pan chewers without tobacco. The higher codes of loss of attachment were seen in pan chewers with tobacco compared with pan chewers without tobacco. It was found that pan chewers with tobacco had 7 times more risk of having loss of attachment when compared with the pan chewers without tobacco.

Conclusions: The results show higher incidence of periodontal diseases in pan chewers who use tobacco compared with pan chewers who do not use tobacco. Based on the results, it was concluded that, although betel nut has deleterious effects on the periodontium, the addition of tobacco leads to a synergistic effect between betel nut and tobacco on the periodontal tissues.

Key words: betel nut, pan, periodontal diseases, tobacco

Oral Health Prev Dent 2008; 6: 223–229. *Submitted for publication: 15.02.07; accepted for publication: 15.08.07.*

Betel nut is an important commercial crop in India and is the seed of the areca nut palm. The custom of chewing betel nut is an ancient one, extending in time to at least several centuries BC. Betel nut is believed to be of medicinal value, and it also plays an integral part in religious, social and cultural rituals. In India, betel nut is used in a variety of forms including plain betel nut in the form of pan (without tobacco) and betel nut with tobacco in the form of pan and gutkha (a mixture of betel nut with tobacco and additives). It is generally used in the form of pan, which contains betel leaf, betel nut, slaked lime, tobacco and other flavouring agents. The use of betel nut has been implicated in periodontal diseases and increased incidence of tooth loss (Neely et al, 2005). The incidence of oral submucous fibrosis is also seen to be higher in betel nut chewers (Yang et al, 2005).

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Tobacco is widely used in India. The various forms of usage are: tobacco smoking, tobacco chewing in the form of pan and tobacco snuff. Habitual pan chewers usually use seasoned tobacco as an additive. In India, tobacco chewing is more common than smoking as tobacco chewing is more socially acceptable.

Tobacco has been implicated as a cause of respiratory diseases and lung cancer. Chewing betel quid containing tobacco has been associated with oral diseases such as oral submucous fibrosis, leukoplakia, oral squamous cell carcinoma and periodontal disease.

It is not known whether or not betel nut with tobacco has an additive effect in causing oral disease. Some *in vitro* studies have shown that arecoline present in betel nut and nicotine present in tobacco have a synergistic effect in causing periodontal destruction when compared with the effects of arecoline alone (Chang et al, 2001).

To evaluate the effects of pan chewing with or without tobacco on periodontal health, a study was designed and carried out at Sirsi, Uttara Kannada District, Karnataka, India.

MATERIALS AND METHODS

The study was conducted in Sirsi Taluk, Uttara Kannada District, Karnataka, India. In this region, pan chewing is a common practice. Agriculture is the main occupation of the people in this region. The main cash crop grown is areca nut.

Samples

A total of 400 subjects from age 35 to 44 years were screened. Three hundred subjects agreed to the examination. The stratified random sampling technique was used to select the sample. The sample size was decided in accordance with the World Health Organization guidelines. Informed consent was obtained from the subjects before subjecting them to evaluation. The ethical approval for the study was obtained from the Head at the Department of Periodontics, Manipal College of Dental Sciences, Manipal University.

The subjects were divided into two groups:

- one hundred and fifty subjects who chew pan with tobacco as an ingredient (group I)
- one hundred and fifty subjects who chew pan without tobacco as an ingredient (group II).

Inclusion criteria:

- one hundred and fifty subjects who chew pan with tobacco as an ingredient for a minimum of five times a day over a period of 5 years or more
- one hundred and fifty subjects who chew pan without tobacco as an ingredient for a minimum of five times a day over a period of 5 years or more.

Exclusion criteria included:

- smokers
- subjects who chew commercially available tobacco or betel nut products
- subjects who suffer from any systemic diseases/conditions that may influence periodontal health.

Materials

The materials used were the mouth mirror, community periodontal index (CPI) probe, gauze piece, tweezers, cotton holder and autoclave.

Information was gathered by questionnaire and oral examination, with the help of a *pro forma* prepared for the study. The following data were recorded.

- General information regarding the subject's name, age, sex, residential address, occupation, education and socio-economic status. Socio-economic status was recorded according to the Modified Kuppuswamy scale, which took into account the education, occupation and income of the subject. Based on this scale, the subjects were divided into five socio-economic strata: upper class, upper middle class, lower middle class, upper lower class and lower class (Mishra and Singh, 2003).
- Past medical history.
- Brushing habits.
- Device used, frequency and method of brushing.
- Chewing habits.
- Frequency and duration of pan chewing without tobacco.
- Frequency and duration of pan chewing with tobacco.

A coding system was used to record all these data.

Table 1 The community periodontal index (CPI)						
Groups	**CPI-0**	**CPI-1**	**CPI-2**	**CPI-3**	**CPI-4**	**Total**
Group I (no. of subjects)	0	10 (6.7%)	43 (28.7%)	52 (34.6%)	45 (30%)	150
Group II (no. of subjects)	1 (0.7%)	28 (18.7%)	79 (52.7%)	31 (20.7%)	11 (7.3%)	150
$\chi^2 = 45.8$; $P < 0.001$, very highly significant; higher CPI codes (code-3 and code-4) are seen in pan chewers with tobacco (group I).						

Examination procedure

Each subject was examined on an ordinary chair under adequate light. The examination was performed starting from the right maxillary sextant and ending at the right mandibular sextant.

Ten sets of instruments were used in the study. Twenty subjects were examined per day: ten in the morning and ten in the afternoon. The instruments were autoclaved once in the morning and once in the afternoon before conducting the examination.

Oral examination

The following three indices were used.

- CPI used for epidemiological surveys (World Health Organization, 1997). This index was selected because of its international acceptance. The oral cavity is divided into six sextants and the highest code for each sextant is recorded. The index consists of two parts. In the first part, the CPI score is recorded and the loss of attachment is then assessed. The highest code for CPI and loss of attachment, among all sextants, was recorded as the CPI and loss of attachment score for the subject. The assessment was done using a CPI probe.
- Gingival Index (GI) (Loe and Silness, 1963).
- The simplified oral hygiene index (OHI-S) (Green and Vermillion, 1964).

Statistical analysis

Descriptive data that included mean, standard deviation and percentages were determined for all the groups. Categorical data were analysed by chi-square test and odds ratio. Continuous data were analysed by the Mann–Whitney test for each code between the two groups. For all the tests a P value of ≤ 0.05 was considered statistically significant, < 0.01 highly significant and < 0.001 very highly significant.

RESULTS

A total of 300 subjects participated in the study. One hundred and sixty-five (55%) were males and 135 (45%) were females. In group I, 87 (58%) were males and 63 (42%) were females. In group II, 78 (52%) were males and 72 (48%) were females. Most of the subjects belonged to the lower socio-economic strata. The majority of the subjects in both the groups used dentifrice and toothbrush as oral hygiene measures (88 subjects in group I and 107 subjects in group II). Most of the subjects performed oral hygiene measures once daily (134 subjects in group I and 138 subjects in group II).

Ninety-nine subjects from group I and 138 subjects from group II chewed 59 pans a day and 45 subjects from group I and 12 subjects from group II chewed 10 to 14 pans a day.

Assessment of periodontal health status was done using CPI and by recording loss of attachment. The CPI score that was highest for all the six sextants was taken as the CPI score of the subject. Of the 300 subjects examined, only one subject from group II had healthy periodontium (code-0). Bleeding on probing (code-1) was the highest CPI code in 10 subjects (6.7%) in group I and 28 subjects (18.7%) in group II. Calculus (code-2) was the highest CPI code in 43 subjects (28.7%) of group I and 79 (52.7%) subjects of group II. Probing pocket depth of 4 to 5 mm (code-3) was the highest CPI code in 52 subjects (34.6%) of group I and 31 subjects (20.7%) of group II. Probing pocket depth of 6 mm or more (code-4) was the highest CPI code in 45 subjects (30%) of group I and 11 (7.3%) subjects of group II. The differences between both group I and group II were found to be statistically significant (Table 1). Further odds ratio calculated for pocket among groups revealed that, group I had 4.7 times more chances of having pockets than group II (Table 2).

Loss of attachment 0 to 3 mm (code-0) was present in 18 subjects (12%) of group I and 73 subjects

Table 2 Odds ratio for pockets

Groups	Pockets			Odds ratio	CI
	+	–	Total		
Group I (no. of subjects)	97	53	150	4.7	2.9–7.7
Group II (no. of subjects)	42	108	150		
Total	139	161	300		

+ indicates the presence of pockets; – indicates no pockets; subjects belonging to group I (pan chewers with tobacco) have 4.7 times more risk of having pockets when compared with subjects belonging to group II (pan chewers without tobacco).

Table 3 Loss of attachment

Groups	Code-0	Code-1	Code-2	Code-3	Code-4	Total
Group I (no. of subjects)	18 (12%)	50 (33.3%)	65 (43.3%)	15 (10%)	2 (1.4%)	150
Group II (no. of subjects)	73 (48%)	52 (34.7%)	18 (12%)	7 (4.6%)	0 (0%)	150

$\chi^2 = 64.8$; $P < 0.001$, very highly significant; higher codes of loss of attachment are seen in subjects belonging to group I (pan chewers with tobacco).

Table 4 Odds ratio for loss of attachment

Groups	Loss of attachment			Odds ratio	CI
	+	–	Total		
Group I (no. of subjects)	132	18	150	7.0	3.9–12.7
Group II (no. of subjects)	77	73	150		
Total	209	91	300		

+ indicates the presence of loss of attachment; – indicates no loss of attachment; subjects belonging to group I (pan chewers with tobacco) have 7 times more risk of having loss of attachment when compared to subjects belonging to group II (pan chewers without tobacco).

(48.7%) of group II. Loss of attachment 4 to 5 mm (code-1) was present in 50 subjects (33.3%) of group I and 52 subjects (34.7%) of group II. Loss of attachment 6 to 8 mm (code-2) was present in 65 subjects (43.3%) of group I and 18 subjects (12%) of group II. Loss of attachment 9 to 11 mm (code-3) was seen in 15 subjects (10%) of group I and 7 subjects (4.6%) of group II. Loss of attachment 12 mm or more (code-4) was seen in two subjects (1.4%) of group I and in no subjects of group II. For all codes of loss of attachment, except for code-1, the differences between group I and group II were found to be statistically significant (Table 3). Further odds ratio calculated for loss of attachment revealed that, group I had 7 times more risk of having loss of attachment compared with group II (Table 4).

The number of subjects having mild gingivitis (code-1) were 35 (23%) in group I and 64 (43%) in group II. The number of subjects having moderate gingivitis (code-2) were 105 subjects (70%) in group I and 82 subjects (55%) in group II. The number of subjects having severe gingivitis (code-3) were 10 (7%) in group I and 4 (2%) in group II. The differences between both the categories for all three codes of gingivitis were found to be statistically significant (Table 5).

Five subjects (3%) in group I and 22 subjects (15%) in group II had good oral hygiene (code-1). Ninety-five subjects (63%) in group I and 102 subjects (68%) in group II had fair oral hygiene (code-2). Fifty subjects (34%) in group I and 26 subjects (17%) in group II had poor oral hygiene (code-3). The differences between both the categories for all three codes of oral hygiene were found to be statistically significant (Table 6).

No significant differences among different CPI codes and socio-economic status were seen. However, incidence of loss of attachment was significantly higher among the lower socio-economic strata when compared to higher socio-economic strata in both the groups.

Table 5 Gingival Index		
Gingival Index	**Group I**	**Group II**
Code-1, mild gingivitis (no. of subjects)	35 (23%)	64 (43%)
Code-2, moderate gingivitis (no. of subjects)	105 (70%)	82 (55%)
Code-3, severe gingivitis (no. of subjects)	10 (7%)	4 (2%)
$\chi^2 = 13.9$; $P < 0.01$, highly significant; majority of the subjects in both the groups have moderate gingivitis.		

Table 6 The simplified oral hygiene index		
Oral hygiene index – simplified	**Group I**	**Group II**
Code-1, good (no. of subjects)	5 (3%)	22 (15%)
Code-2, fair (no. of subjects)	95 (63%)	102 (68%)
Code-3, poor (no. of subjects)	50 (34%)	26 (17%)
$\chi^2 = 18.5$; $P < 0.001$, very highly significant; majority of the subjects in both the groups were seen to have fair oral hygiene.		

Oral hygiene devices used did not seem to have any influence on CPI scores of subjects in both the groups. However, there was a significantly higher loss of attachment among subjects belonging to group I who used indigenous devices for brushing.

Frequency and method of brushing did not seem to have any effect on CPI scores and loss of attachment in both the groups.

Frequency and duration of chewing were seen to have a significant association with CPI codes in group I. With increase in the frequency and duration of chewing, higher CPI codes were seen. This relationship was found to be statistically significant. However, this difference was not seen among subjects belonging to group II.

In both the groups, the frequency and duration of chewing were not seen to have a significant association with loss of attachment.

DISCUSSION

The study was conducted in Sirsi, a particular geographical area, for a number of reasons. This belt is typical for its pan chewing habits. This is one of the few areas in India where pan chewing without tobacco is also practised. Most of the population in this area work in areca nut plantations and have a very similar lifestyle, food habits and oral hygiene habits. Thus, there were very few confounding factors.

Smokeless tobacco has been implicated in periodontal diseases. In the present study, increased pocket depth and loss of attachment were observed in subjects using pan with tobacco, compared with subjects using pan without tobacco. Similar observations have been noted in various studies. It has been seen that there is an increased incidence of gingival recession among smokeless tobacco users (Greene and Poulson, 1983). Increased attachment loss among smokeless tobacco users has been documented (Offenbacher and Weathers, 1985). The odds of having gingival recession was found to be 7 times greater in users compared with non-users (Offenbacher and Weathers, 1985). Increased attachment loss in smokeless tobacco users has been attributed to the abrasive nature of smokeless tobacco products and also vigorous brushing in the area of placement. But, they did not find any increased incidence of periodontitis. The reason could be that the study population was among major league baseball players in USA. Thus, all the subjects belonged to the younger age group (Robertson et al, 1990). However, it has also been reported that smokeless tobacco users were twice as likely to have severe active periodontal disease at any site when compared to nonusers and nonsmokers (Fischer et al, 2005).

Nicotine has been shown to have a deleterious effect on the gingival fibroblasts (Giannopoulou et al, 2001). Effects of nicotine on the cellular protein synthesis and its modulation of beta 1 integrin expression may impair the ability of gingival fibroblasts to adhere and communicate with one another and with the extracellular matrix. Thus, the use of tobacco products may exacerbate periodontal disease (Snyder et al, 2002). Nicotine may have a deleterious effect on human periodontal ligament fibroblast growth, proliferation and protein synthesis, and thus may have a role in periodontal diseases (Chang et al, 2002). Nicotine is also known to cause reduction of gingival blood flow (Nakamura et al, 2005).

Nicotine and arecoline together have a synergistic effect on the periodontium. In an *in vitro* study, it has been found that arecoline significantly inhibited the growth of periodontal ligament fibroblasts. Furthermore, the addition of nicotine created a synergistic effect on the arecoline induced toxicity. Thus, it was concluded that subjects chewing betel nut with tobacco in any form could be more susceptible to periodontal damage than betel chewing alone (Chang et al, 2001). Betel chewing with tobacco has been reported to influence the cytomorphology of the mucosa (Ramaesh et al, 1999).

It is surprising that oral hygiene devices used did not seem to have any influence on CPI scores of subjects in both of the groups. The effects of the devices used may have been masked by the effects caused by the chewing habits. However, a significantly higher loss of attachment was found among subjects belonging to group I who used indigenous methods of brushing. A similar finding has been reported in a Bangladeshi population (Eswar, 2002).

Frequency and duration of chewing were seen to have a significant association with CPI codes in group I. With increase in the frequency and duration of chewing, higher CPI codes were seen. However, this difference was not seen among subjects belonging to group II. In both the groups, the frequency and duration of chewing were not seen to have a significant association with loss of attachment. Similar findings have been reported in an Indian study (Pathak and Boghani, 1979).

The number of subjects with mild gingivitis was significantly higher among subjects belonging to group II when compared with group I. Similarly, a significantly higher incidence of moderate and severe gingivitis was seen in group I when compared with group II. This may be attributable to the synergistic effects of arecoline and nicotine on the gingiva (Chang et al, 2001).

The number of subjects with good oral hygiene was greater in group II and the number of subjects with poor oral hygiene was greater in group I. However, the majority of both the groups had fair oral hygiene. A deterioration of oral hygiene status among tobacco chewers has been reported (Pathak and Boghani, 1979).

CONCLUSIONS

The present study was conducted in Sirsi Taluk, Uttara Kannada District, Karnataka. A total of 300 subjects belonging to the 35 to 44-year-age group participated in the study; 150 of the subjects belonged to pan chewing with tobacco category and 150 belonged to pan chewing without tobacco category. Though many studies on the individual effects of betel nut and tobacco have been conducted, this is the first study that aims to probe the synergistic effects of betel nut and tobacco.

The following observations were made based on the analysis of the collected data.

- There was significantly higher prevalence and severity of periodontal disease in pan chewers with tobacco when compared with pan chewers without tobacco. Pan chewers with tobacco had 4.7 times more risk of having pockets when compared with pan chewers without tobacco. Pan chewers with tobacco had 7 times more risk of having loss of attachment when compared with pan chewers without tobacco.
- There was a significantly higher prevalence and severity of gingivitis in pan chewers with tobacco when compared with pan chewers without tobacco.
- Further studies need with be conducted to support the basic observations of our study.

Based on these observations, it can be concluded that, although pan chewing by itself is a cause of injury to the periodontal tissues, the addition of tobacco leads to a synergistic effect of pan and tobacco on the periodontal tissues.

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