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Original Article

Dentistry Section

Association of Xerostomia and Assessment of Salivary Flow Using Modified Schirmer Test among Smokers and Healthy Individuals: A Preliminary Study

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ABSTRACT

Background and Objective: Several oral diseases such as dental caries, periodontitis and oral infections can be a major concern in patients suffering from mouth dryness. Whole mouth salivary flow is affected by many factors which may include habits like smoking. The aim of the present study was to investigate the incidence of xerostomia and hyposalivation among smokers.

Materials and Methods: The study groups included 60 smokers and 60 healthy non-tobacco users as case and control groups respectively. A questionnaire was used to collect the smoking habits and symptoms associated with xerostomia. Measurement of unstimulated whole mouth salivary flow for three minutes was performed using modified Schirmer test. The results were subjected to statistical analysis.

Results: The prevalence of xerostomia symptom was 37% in smokers and it was 13% in non-smokers, with a statistically significant difference between groups (p=0.003). The prevalence of hyposalivation was 43% in smokers, whereas it was only 8% in the control group (p< 0.001).

Conclusion: Xerostomia symptoms with significant reduction in unstimulated whole mouth salivary flow were associated with long term smoking.

Keywords: Xerostomia, Hyposalivation, Modified Schirmer test, Mann-whitney test

INTRODUCTION

Saliva is a complex biological fluid which maintains homeostasis of the oral cavity [1-3] and keeps oral mucosa healthy [4,5]. It has other properties like antimicrobial and anti-fungal activities, it transports digestive enzymes, it helps in re-mineralization of teeth and assists in speech, mastication and deglutition by lubricating oral cavity [5-7].

Reduced saliva flow has deleterious effects on oral health. It increases risk of dental diseases like dental caries, periodontitis, oral infections like candidiasis [6,7]. It induces symptoms like halitosis, burning and oral soreness, difficulty in mastication and speech, dysgeusia, dysphagia [6-9].

Xerostomia is the subjective feeling of having a dry mouth, whereas hyposalivation indicates a reduced salivary flow rate [6]. Earlier studies have suggested that dry mouth does not always coincide with hyposalivation [10]. Therefore, the terms, 'xerostomia' and 'hyposalivation' are used independently, as salivary flow and xerostomia symptoms have a poor correlation [5].

The measurement of xerostomia is difficult in contrast to that of hyposalivation, which can be objectively evaluated by using sialometry. Xerostomia is a set of symptoms and a single measurement method cannot reflect every aspect of the patient's situation. Direct questioning is a relatively accurate method which can be used to assess xerostomia; therefore, this study included multiple questionnaires that were concerned with the dry mouth situation [10].

Smoking is an addictive habit and the most important cause of preventable death and disease. Currently, one-third of adult population are smokers [11]. The number of cigarette smokers is slowly declining, but the frequency is increased in those who do smoke. Tobacco consumption is rising in developing countries, where greater economic benefits are brought by tobacco production, and it will probably continue to rise for the foreseeable future [12].

Smoking is thought to be as one of the risk factors which reduces salivation and xerostomia [8,13]. Oral mucosa is bathed by saliva and therefore; saliva is the first to interact with cigarette smoke [3]. Cigarette smoke contains 4000 bioactive chemical compounds, 300 carcinogens which cause structural and functional changes in saliva [11,13].

The effect of smoking on salivary flow is controversial. Studies have shown that there was an increase in Salivary Flow Rate (SFR) in short term tobacco users [14], while others have shown that there was no significant change in SFR between tobacco and non-tobacco groups. Increase in salivary flow is seen in those who begin smoking, due to increase in activity of salivary gland, but some tolerance develops in habitual smokers [13,14]. Therefore, the aim of the present study was to document the incidence of xerostomia and hyposalivation in smokers and non-smokers.

MATERIALS AND METHODS

Patient Selection

The study population consisted of patients who were referred to the Department of Oral Medicine and Radiology, the Oxford Dental College, for routine dental care over a period of three months. The test group consisted of individuals who had long term smoking habit daily, for more than six months, with no other associated habits. The control group comprised of healthy non-tobacco (smoking and smokeless) users. Each group comprised of 60 apparently healthy adults that were matched with respect to age and sex.

The exclusion criteria included alcohol consumption, denture wearers, a history of radiotherapy, and patients with systemic or salivary gland diseases or those who were under any drug therapy.

The method was explained to all the patients and informed consents were obtained from them. Standard proforma was made to record the demographic, study details and questionnaire on the xerostomia in smokers and healthy individuals.

Assessment of Xerostomia

[Table/Fig-1] shows six questions, modified from Fox PC et al., and Pai S et al., questionnaires [9,15], which were used to assess the patients' feelings of mouth dryness. Based on the severity of symptoms, patients were classified as mildly, moderately and severely xerostomic.

Modified Schirmer Test Procedure (MST)

Unstimulated whole saliva was measured by performinutesg MST. According to Fontana M et al., [16], the MST was performed for all the participants between 9 am to 12 pm. Before performing the test, all the participants refrained from eating and drinking for two hours. After a few minutes of relaxation, subjects were asked to sit upright in a dental chair. To clear the salivary secretion in the mouth, the subjects were asked to swallow once and they were told not to swallow during the test. Also, while perfoming the test, the subjects were asked to raise their tongues and they were retracted gently, to avoid inadvertent wetting of the test strips. With the help of cotton plier, the test strip was held vertically and the rounded end was positioned on the floor of the mouth, either to the right or the left of the lingual frenum. The colour of the strip changed to brown on wetting. Based on the length of wetting, readings were recorded immediately at one minute, two minutes and three minutes intervals. In the present study, a reading of <25mm which was obtained at three minutes was considered as indicative of hyposalivation.

STATISTICAL ANALYSIS

To analyze the xerostomia, hyposalivation and mean salivary flow between smokers and non-smokers Mann-Whitney test was performed. The association between xerostomia and hyposalivation was analyzed by Chi-square test. Means and standard deviation were calculated. The SPSS version 13.0 package Windows program was used for statistical analysis. The p-values of less than 0.05 were considered to be statistically significant.

RESULTS

Subjects

The study group consisted of 60 smokers and 60 healthy subjects. The mean ages for smokers and healthy group were 36.98 ± 11.52 years and 32.45 ± 9.18 years respectively. Among the smoker group, 46 (77%) subjects who had the habit of cigarette smoking were more in number than beedi smokers 14 (23%). Beedi smokers had the habit of smoking for a prolonged duration (20.71 ± 12.82 years) as compared to cigarette smokers (10.00 ± 6.71 years). Mean frequency for beedi smoking (11.64 ± 6.61 beedi per day) was more as compared to that of cigarette smoking (5.59 ± 2.70 cigarettes per day).

Prevalence of Xerostomia and Hyposalivation

Xerostomia was reported in 22 (37%) smokers and in 8 (13%) non-smokers (P=0.003). Among the smokers, 32% subjects reported mild xerostomia, 7% reported moderate xerostomia and none of them reported severe xerostomia, whereas among the healthy group, 13% had mild xerostomia and none of them reported moderate or severe xerostomia. The association between xerostomia and the smokers group was found to be statistically significant (p<0.001).

Hyposalivation was present in 26 (43%) smokers and in 5 (8%) non-smokers. The association between hyposalivation and the smokers group was found to be statistically significant (p<0.001). Higher numbers of subjects in smoking group were found to have xerostomia and hyposalivation as compared to those in the healthy group.

Salivary Flow Rate

[Table/Fig-2] shows that the mean saliva flow at 1minutes, 2minutes and 3minutes was significantly lower (p<0.001) in the smoker group as compared to that in the healthy group.

Association between Xerostomia and Hyposalivation

[Table/Fig-3] shows that the presence of both xerostomia and hyposalivation was seen in 16 smokers and 4 healthy subjects, whereas 28 smokers and 51 healthy subjects presented with neither xerostomia nor hyposalivation. The association between xerostomia and hyposalivation in both the groups was found to be statistically significant (p<0.001). Higher numbers of subjects with the presence of xerostomia were also found to have the presence of hyposalivation.

1.	Do you feel your mouth is dry?	Mild xerostomia
2.	Do you sip liquids to aid in swallowing dry food?	
3.	Do you feel thirsty very frequently?	Moderate xerostomia
4.	Do you have difficulties swallowing any food?	
5.	Does your mouth feel dry throughout the day?	Severe xerostomia
6.	Do you chew gum/hard candies/minutest daily to relieve oral dryness?	

[Table/Fig-1]: Modified questionnaire for assessment of xerostomia.

	Smokers	Healthy	p-value
At 1 minutes	9.38 ± 3.72	12.15 ± 3.88	p<0.001
At 2 minutes	17.62 ± 3.88	22.97 ± 6.17	
At 3 minutes	25.08 ± 5.94	31.07 ± 5.48	

[Table/Fig-2]: Unstimulated mean saliva flow among smokers and non-smoker individuals.

	Smokers group (60)		Non-smoker group (60)		p-value
	Hyposalivation		Hyposalivation		
Xerostomia	Present	Absent	Present	Absent	p<0.001
Present	16 (26.66%)	6 (10%)	4 (6.66%)	4 (6.66%)	
Absent	10 (16.66%)	28 (46.66%)	1 (1.66%)	51 (85%)	

[Table/Fig-3]: Association between xerostomia and hyposalivation among smokers and non-smoker groups.

Among the smokers group, 26 subjects who had hyposalivation, 10 (16.66%) did not have symptoms of xerostomia, whereas 22 subjects who reported symptoms of xerostomia 6 (10%) did not have hyposalivation. Similarly, in the healthy group, among five subjects who had hyposalivation 1 (1.66%) did not have symptoms of xerostomia, whereas among eight subjects who reported symptoms of xerostomia, 4 (6.66%) did not have hyposalivation.

DISCUSSION

In the present study, we investigated the presence of xerostomia and hyposalivation among smokers and non-smokers. Our results showed that 37% smokers and 13% non-smokers reported xerostomia symptoms. 43% smokers and only 8% non-smokers had hyposalivation, based on MST value of <25 mm at 3 minutes.

Saliva is the principle defense factor of the oral cavity. General state of hydration depicts salivary secretion, but in clinical practice, saliva flow is mainly affected by systemic diseases, drugs and associated habits [17].

The salivary flow and composition greatly vary under different conditions. Per day, approximately 0.5 litres of saliva are secreted. The unstimulated salivary flow rate is 0.3 ml per minutes and when it is stimulated, it increases to 1.5-2 ml per minutes, whereas during night time, salivary flow rate is negligible [14]. Xerostomia suggests a decrease in at least 50% of unstimulated salivary flow rate [5].

It has been suggested that aging causes parenchymal atrophy which leads to decrease in saliva flow, but some authors have shown that healthy older people had normal salivary flow rates. Therefore, the present study included a wide range of age groups [8].

Fontana M et al., [16], evaluated the association between the MST and other traditional methods like volumetric/gravimetric methods. In all tests, MST was found to be a simple, practical, inexpensive, standardized and easy to perform method in clinical practice [6,18]. Therefore, this study included MST, to measure the unstimulated salivary flow rate.

Studies have shown that MST value of <25 mm at 3 minutes, suggestive of hyposalivation, provided high sensitivity and specificity [16]. Another study showed that MST value of >28 mm at 3 minutes was normal. Chen A et al., indicated that an MST value of <15 mm at

3 minutes was suggestive of severe xerostomia and hyposalivation [19].

Among all habits, smoking is linked with mouth, as tobacco smoke spreads to all parts of the oral cavity. It has been presumed that long term tobacco smoking decreases sensitivity of taste receptors, leading to a depressed salivary reflex [13,14].

Previous studies have shown that smoking causes an increase in activity of salivary gland, leading to short term increase in salivary flow rate, that begins with smoking. Some individuals develop tolerance during long term smoking. Bouquet and Schroeder reported that the long term effects of tobacco use were unclear. It has been shown that intense smokeless tobacco use resulted in degenerative changes in salivary gland [13].

A number of studies have shown that salivary flow is reduced in smokers as compared to that in non-smokers. The results of the present study are comparable to those of studies, that have shown that smoking was one of the risk factors for xerostomia and hyposalivation [13]. However, few studies have shown no significant changes in salivary flow in smokers [13,14].

A questionnaire is a good screening tool for assessing xerostomia. In the present study, the assessment of xerostomia was done by using multiple questionnaires on dry mouth symptoms and behaviour. Studies have shown that 70.1% respondents had dry mouth symptoms and behaviour [10] whereas Torres et al., reported that 71.2% had the same, using same criteria [20].

However, few studies have shown that questionnaire results did not correlate well with saliva flow. In the present study, the authors found that 35.48% of subjects who had hyposalivation, did not have xerostomia. Similarly, 33.33% of subjects who reported xerostomia symptoms, did not have hyposalivation. In another study, 34% of patients who had hyposalivation, did not have xerostomia and 37% of patients who reported xerostomia, did not have hyposalivation, which was comparable to results of present study [18].

In another study, the mean resting whole mouth salivary flow rate was 0.38 ml/minutes in smokers, whereas it was 0.56 ml/minutes in non-smokers by spitting method, which was significantly lower in smokers [13]. These results were comparable to those of the present study. The mean salivary flow as per modified Schirmer test at 3 minutes was found to be significantly lower ($p<0.001$) in smokers than that in non-smokers.

Among the subjects who responded to xerostomia symptoms, 66.66% showed hyposalivation. Therefore, the present study suggests that salivary flow test should be performed in patients who complain of xerostomia, to document hyposalivation.

Previous studies have shown that smoking significantly increased oral and dental disorders associated with dry mouth, especially cervical caries, gingivitis, tooth mobility, calculus [13], periodontal diseases, halitosis, plaque retention, poor oral health status [12], mutagenic alteration of oral mucosal cell [3], and that it increased mortality risk [21].

CONCLUSION

The results of our study showed that smoking significantly reduced the unstimulated salivary flow rate and that it significantly increased dry mouth symptoms. The MST can be used as a reliable, objective, inexpensive, easy-to-perform and well-tolerated test for assessment of hyposalivation. Our study illustrated prevalent, but under-investigated oral health problems in smokers. The immediate implication obtained from the present study is to treat smokers by assessing xerostomia symptoms and hyposalivation, most importantly, by counseling them to quit the habit. The main limitation of this study was small sample size. Therefore, to authenticate our results, further studies with large sample sizes should be undertaken.

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