

Alteration in Taste Perception Salivary Ph & Flow Rate among OSMF & Leukoplakia – A Case Control Study

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Abstract

Background & Aim: Saliva is the first biological fluid exposed to noxious products like tobacco and arecanut. Habitual use can lead to functional and structural changes in saliva in addition to oral lesions. This study aims to analyse and compare the effects on tobacco and tobacco related products on taste perception, salivary pH and flow rate among subjects with OSMF and leukoplakia lesions.

Materials And Method: A study was conducted to assess and compare the salivary pH, flow rate and taste perception among 45 patients within 20-50 years of age who visited Meenakshi Ammal Dental College & Hospital for various dental treatments. The population was divided equally into three subgroups of OSMF, leukoplakia and systemically healthy control groups. Schirmer strips, pH strips and taste strips were used to assess Salivary flow rate, pH and taste perception respectively for all the patients.

Results: A statistical significance p value of < 0.05 was obtained. The results of the study showed that there is a definite alteration in the salivary properties like pH, flow rate and taste perception among OSMF and leukoplakia subjects on comparison with the controls. The OSMF

subjects had greater affinity for alteration when compared with leukoplakia subjects.

Conclusion: Assessment of the saliva with various strips can be used as a chair side investigation procedure. Apart from the risk of malignancy, the loss of taste perception can lead to depression and anorexia, therefore affecting the quality of life. These investigations being completely noninvasive will be a definite contemporary in future.

Keywords: Salivary pH, salivary flow rate, Taste perception, OSMF, leukoplakia.

Introduction

Saliva is a complex fluid that helps in maintaining oral mucosal integrity. It is composed of organic, inorganic and other macromolecules. Daily secretion of saliva ranges from 0.75 to 1.5 L/day. The normal pH of saliva is 7.0 whereas pH below 7.0 is considered to be acidic pH and above 7.0 is considered to be alkaline pH. The main function of saliva is that, it protects the hard and soft tissues of the oral cavity through its cleansing, lubricating, and anti-microbial properties.

It is said that saliva reflects the physiological state of the body and is recognized as the body's mirror. Saliva being completely non-invasive diagnostic tool has crossed

milestone in diagnosing propensity in medical and dental research. Early diagnosis of diseases is crucial to prevent complications that could have a negative impact on a patient's quality of life ¹.

Saliva is the first critical biological fluid that is exposed to harmful noxious products like tobacco and related products in the oral cavity. Tobacco consumption is considered as one of the most important public health hazard worldwide, yet it is consumed in various forms such as smoking, chewing, snuff dipping and betel quid with arecanut etc ². The long term usage of tobacco and arecanut can give rise to premalignant or potentially malignant oral lesions which finally could lead to oral malignancy. The incidence rate of oral squamous cell carcinoma varies widely worldwide. Tobacco either in smoked or in smokeless form, is one of the most commonly used psychoactive substance ³. The net physiological effect is based on the components of tobacco or arecanut, their ratio, bioavailability, frequency of intake, duration of habit, and exposure time per use. All these are said to result in an alteration of quantity and quality of saliva.

Tobacco in smoking forms are the cigarettes, cigars, beedi and loose tobacco in pipes. Smokeless form include the paan masala, hans, mawa, betel quid with slaked lime etc. It is said that nicotine is the main ingredient of tobacco, acts on certain cholinergic receptors in the brain and other organs causing neural activation leading to altered salivary secretion. This might lead to altered taste receptors response and also changes in the salivary flow rate and pH. Leukoplakia is the common premalignant lesion that arises from smoking form of tobacco and Oral submucous fibrosis in the case smokeless form of tobacco arecanut. Fibrosis of the oral mucosa which is an avid presentation of OSMF, can lead to decreased salivary flow rate due to the obstruction of the duct opening. The

effect of arecoline which leaches into the oral cavity also said to act upon the biocarbonate buffering system thereby altering the pH of saliva and also causes atrophy of the papilla ^{4,5}.

There are five taste qualities identified like the salt, sweet, bitter, sour and umami. Altered taste perceptions of the taste receptors are referred to as dysguesia and complete loss of taste perceptions as aguesia. Alterations in taste perception can lead to decreased appetite leading to anorexia and depression thereby affecting the quality of life in patients ⁶.

Based on these facts, it could be postulated that tobacco use can adversely affect the salivary glands resulting in an alteration in quality and quantity of saliva.

With this background, the present study was done aiming to assess and compare the taste perception, salivary pH and salivary flow rate among, patients with chronic tobacco related habits diagnosed with Oral submucous fibrosis and leukoplakia..

Materials and Methods

A case control study was conducted in the department of Oral medicine & Radiology, Meenakshi Ammal Dental college & hospital, Maduravoyal, Chennai, India. The study was presented for Ethical clearance and was approved by the Institutional review board (IRB) committee of Meenakshi Ammal Higher Education and Research (MAHER).

The study population consisted of 45 out patients who visited the department for various dental treatment, within an age group of 20 to 50 years of age. The study population were equally divided into three different groups of 15 subjects in each group.

Group A: 15 patients with OSMF (GRADE III – GRADE V) Gupta et al classification.

Group B : 15 patients with leukoplakia .

Group C : 15 patients systemically healthy and without any habits considered as controls.

Patients aged from 20 years to 50 years of age, patients with habit history of smoking , chewing tobacco for more than 6 months with clinically diagnosed as OSMF and leukoplakia and systemically healthy control group without any deleterious habits were included in this study. Patients excluded were in the age group above 50 years, under systemic medications and patients with any systemic diseases

The study was done in the morning hours between 9.00 am to 12.00 am to avoid diurnal variation. The subjects were asked not to eat or drink 1 hour prior to procedure and asked the rinse the mouth in tap water.

The Schirmer paper strip was used to assess the salivary flow rate by the modified schirmer test procedure , pH indicator strips to assess the salivary pH and taste strips , Sweet (sucrose) , sour (PTC – 17 -4010) , salt (sodium benzoate 17 -4020) , bitter (Thiourea 17-4030) for taste perception from Carolina biologicals were utilized .

Salivary Flow Rate Assessment

The patient is asked to swallow all the saliva in the mouth before the test, and not to swallow anymore during the test. In addition, the patient is asked to rest the tongue on the hard palate, so that the test strip would not touch the tongue during the test. Unstimulated salivary test was done by the Modified schirmer test method. This a variation of schirmer's tear test procedure , where the strip is held vertically with a cotton plier such that the rounded end of the strip is positioned at the floor of the mouth . When the round end of the strip contacts moisture, the saliva travels up the strip and its distance is read at the end of 1, 2, and 3 min and recorded immediately. The normal Salivary flow rate ranges between 25 mm and 30 mm. It is considered dry mouth when Salivary flow rate drops between 10 mm and 15 mm, moderately dry when

value ranges from 6 mm to 10 mm and considered severely dry with Salivary flow rate 00–01mm(**fig : 1**)



Fig. 1: Schirmer tear strips to check the salivary flow rate **Salivary pH**

Salivary pH is measured using the pH strips. Stimulated saliva is collected from the floor of the mouth through the submandibular ducts. The change in color of the strip is noted and matched with the color coding based on the pH strip and noted accordingly. The normal salivary pH ranges from 6.5 to 7.5. A pH value below 6.5 indicates acidic pH, and it is considered alkaline when pH increases above 7.5.fig:2.

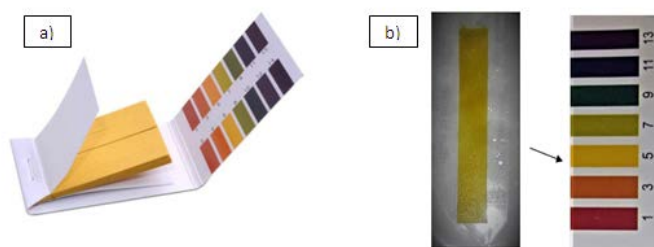


Fig :2 a) salivary pH strips b) a tested pH strip showing a pH value of 5(acidic)

Taste Perception

The taste strips were four in number with the four basic tastants , i.e., sweet, salty, sour, and bitter. Each taste strip with specific taste was placed over the dorsum portion of the tongue, and the subject was asked to identify the taste of the strip. The patient was asked to rinse the mouth after

recording each taste. The taste perceived by the subjects in vernacular languages were recorded as normal , dysgeusia, and ageusia. The data recorded was tabulated and subjected for stastical analysis.fig:3.



Fig : 3 Taste strips

Results

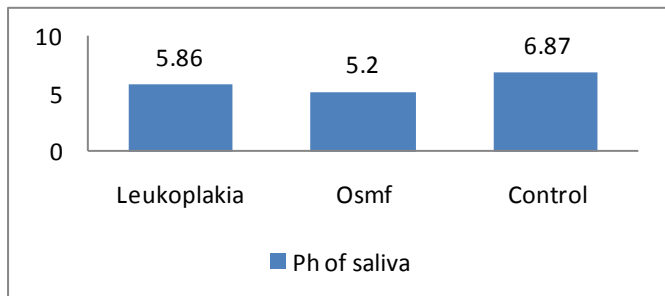
The mean age group of the individuals in study Group I (OSMF) is 39.33 + 8.6, Group II (Leukoplakia) is 42.87 +

9.5, and Group III (Controls) is 27.87 + 4.7 years. The mean of habit duration (in months) in group I and group II was 100.33 ± 5.72 and 190 ± 12.9 respectively. Mean, standard deviation were calculated for all quantitative data and inter group comparison was carried out using ANOVA followed by Tukeys post hoc analysis. Intra group analysis for paired data was carried out using paired test. Confidence intervals were set at 95 % and p value < 0.05 was considered to be statistically significant.

The mean salivary pH value estimated in Group I is 5.20 + 0.5, Group II is 5.86+ 0.7 , and Group III is 6.87+ 0.2. A pH value within a range of 6.5 to 7.5 is generally considered as a neutral pH. On comparison of the pH among the three groups, it showed that a decrease in pH levels was seen in Group I (OSMF Subjects) than Group II (Leukoplakia subjects) (table: 1 , graph: 1).

Table 1: Descriptive analysis of the data with mean values of Age , habit Duration , Salivary pH & flow rate

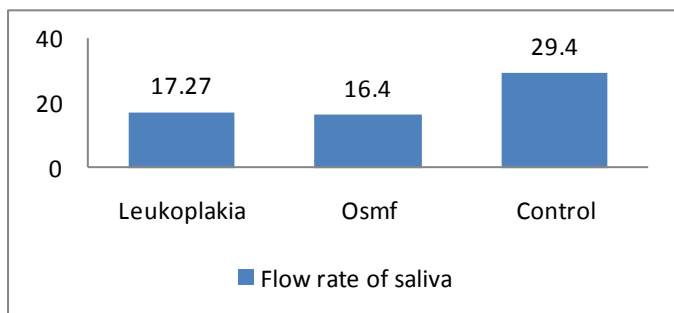
	N	Mean	Std. Deviation	Std. Error	95% confidence interval for mean		
					Lower bound	upper bound	
Age	Control	15	27.87	4.734	1.16	25.73	30.33
	Leukoplakia	15	42.87	9.553	2.43	37.74	47.13
	OSMF	15	39.33	8.674	2.11	35.27	43.20
Ph	Control	15	6.87	0.229	0.06	6.73	6.97
	Leukoplakia	15	5.86	0.766	0.18	5.46	6.20
	OSMF	15	5.20	0.528	0.13	4.93	5.43
Duration	Control	15	0.00	0.000	0.00	0.00	0.00
	Leukoplakia	15	19.00	12.967	3.37	12.80	25.73
	OSMF	15	10.33	5.728	1.45	7.80	13.46
Flow rate	Control	15	29.40	2.293	0.58	28.20	30.53
	Leukoplakia	15	17.27	3.432	0.86	15.60	19.00
	OSMF	15	16.40	2.261	0.59	15.27	17.67



Graph 1: Mean salivary pH among OSMF , Leukoplakia & Controls

The mean salivary flow rate measured using modified schirmer strips method among Group I is 16.40±2.26 mm , Group II is 17.27±3.43 mm and Group III – 29.40± 2.29 mm .

On comparison of flow rate between the three groups showed that there was a decrease in salivary flow rate in Group I (OSMF subjects) than Group II (Leukoplakia Subjects).Table : 1 , graph : 2)



Graph 2: Mean Salivary flow rate among OSMF, Leukoplakia & Controls

Comparisons of taste perception among three groups showed the following results- (Table :2).

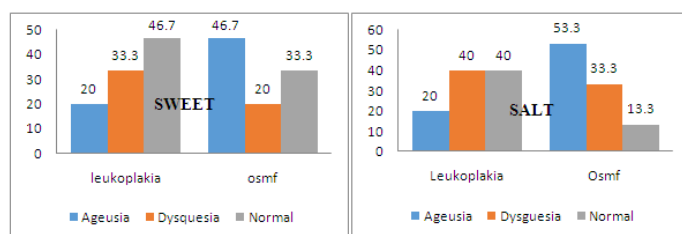
Comparisons of taste perception among three groups showed the following results- (Table :2).

leukoplakia	sweet	salt	bitter	sour
mean	1.87	2.00	2.47	1.47
Std.dev.	.915	.926	.743	.640

OSMF	SWEET	SALT	BITTER	SOUR
Mean	1.87	2.20	1.67	1.93
Std. Deviation	.743	.676	.724	.799

Table 2: mean, std.dev of tastes among leukoplakia & OSMF

In OSMF patients the sweet taste showed - 46.7% - Aguesia ; 20% - Dysguesia ; 33.3% - normal taste and in leukoplakia patients the sweet taste - 20.0% aguesia ; 33.3% - Dysguesia ; 46.7% -normal taste (graph : 3).

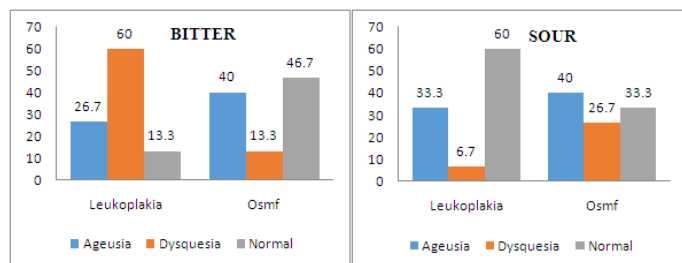


Graph:3 distribution of sweet & salt taste perception among OSMF & leukoplakia groups

In OSMF patients the salt taste showed 53.3% -Aguesia ; 33.3% - Dysguesia ; 13.3% - normal taste and leukoplakia patients showed - 20% - Aguesia ; 40% - Dysguesia ; 40% - normal taste (graph : 3).

In OSMF patients the bitter taste showed 40% - Aguesia, 13.3% - Dysguesia ; 46.7% - normal taste and leukoplakia patients showed 26.7% - Aguesia ; 60% - Dysguesia ; 13.3% - normal taste (graph : 4)

In OSMF patients the sour taste showed 40% - Aguesia, 26.7% - Dysguesia ; 33.3% - normal taste and leukoplakia patients showed 33.3% - Aguesia ; 6.7% - Dysguesia ; 60% - normal taste (graph : 4)



Graph:4 distribution of bitter & sour taste perception among OSMF & leukoplakia groups

On the whole the salivary pH and flow rates are decreased in OSMF subjects when compared with leukoplakia . Aguesia is seen more in Group – I (OSMF) subjects when compared with Group – II (Leukoplakia) subjects and Group – III (controls). This shows Group - I OSMF

condition have more prone for altered salivary properties and taste perception than Group – II leukoplakia.

A p value < 0.05 was obtained by ANOVA test indicating there is a statistical significance between the mean value of salivary pH, taste perception and salivary flow rate among OSMF , leukoplakia groups and controls.(table : 3).

	Sum of Squares	df	Mean Square	F	Sig.
Age	224.900	7	32.129	.214	.040
	1052.833	7	150.405		
Ph	.097	1	.097	.155	.020
	8.136	13	.626		
Flow Rate	39.933	7	5.705	.319	.002
	125.000	7	17.857		
Sweet Between Groups	21.121	21	1.006	3.949	.001
Within Groups	5.857	23	.255		
Total	26.978	44			
Salt Between Groups	15.443	21	.735	1.101	.049
Within Groups	15.357	23	.668		
Total	30.800	44			
Bitter Between Groups	23.387	21	1.114	3.260	.004
Within Groups	7.857	23	.342		
Total	31.244	44			
Sour Between Groups	10.676	21	.508	1.111	.031
Within Groups	10.524	23	.458		
Total	21.200	44			

Table 3: Anova test between controls , OSMF and leukoplakia group , **p value <0.005

INDEPENDENT t test was done to find the significance between salivary pH, flow rate and taste perception among Group I (osmf) and Group II(leukoplakia) subjects. A p value of < 0.05 indicating there is a statistical significance

between salivary pH, flow rate and taste perception among Group I and Group – II subjects.(table :5)

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
DURATION	Equal variances assumed	17.675	.000	-2.368	28	.025	-8.667	3.660	-16.164	-1.169
	Equal variances not assumed			-2.368	19.263	.028	-8.667	3.660	-16.320	-1.013
PH	Equal variances assumed	.630	.004	-2.774	28	.010	-.6667	.2404	-1.1590	-.1743
	Equal variances not assumed			-2.774	24.833	.010	-.6667	.2404	-1.1619	-.1714
flow rate	Equal variances assumed	2.583	.019	-.817	28	.031	-.867	1.061	-3.041	1.307
	Equal variances not assumed			-.817	24.228	.032	-.867	1.061	-3.056	1.323
SWEET	Equal variances assumed	2.415	.001	.000	28	.000	.000	.304	-.624	.624
	Equal variances not assumed			.000	26.866	.000	.000	.304	-.625	.625
SALT	Equal variances assumed	3.294	.020	.676	28	.005	.200	.296	-.406	.806
	Equal variances not assumed			.676	25.626	.005	.200	.296	-.409	.809
BITTER	Equal variances assumed	.021	.005	-2.987	28	.006	-.800	.268	-1.349	-.251
	Equal variances not assumed			-2.987	27.980	.006	-.800	.268	-1.349	-.251
SOUR	Equal variances assumed	.196	.002	1.766	28	.008	.467	.264	-.075	1.008
	Equal variances not assumed			1.766	26.728	.009	.467	.264	-.076	1.009

Table : 5 Independent t test ; *p value < 0.05 is highly statistically significant

Discussion

Saliva is an important biological fluid that reflects the physiological state of the body and is known as the body’s mirror. With its non invasive diagnosing tool property it could be a definite diagnosing propensity in medical and research.⁶ Tobacco consumption though considered as one of the most important public hazard worldwide , is still consumed in smoking and smokeless forms .The net physiological effect is based upon the components of tobacco or arecanut , their ratio, bioavailability, frequency of intake, duration of habit, and exposure time per use.

Apart from giving rise to various oral potentially malignant disorders like OSMF and Leukoplakia , the toxic effects of tobacco are said to have a definite alterations on the quantity and quality of saliva . In addition there is also an alteration in the taste perception. Based upon the significance of this study we can definitely propose that salivary characteristics like pH, flow rate & taste perception as a chair side investigating procedure to enhance patient management. The results of the present study revealed that there is a definite alteration in the salivary properties among OSMF

and Leukoplakia subjects. With the OSMF subjects more prone for alteration in salivary properties on comparison with Leukoplakia subjects. The same group also showed a positive effect for increased affinity for alteration in taste perception.

In relation to the alteration of salivary pH and flow rate, our study was in accordance with the results of the following studies. Mandana Donoghue et al 2015 did an analysis of salivary pH in 30 OSMF diagnosed subjects. This study also proved that there is a significant decrease in pH levels. The main background behind this is that as the arecoline leaches into the mucosa, it has a negative impact on the bicarbonate buffering system and altering them which plays an important role in maintain the salivary pH.⁹

Faisal rehaan et al 2018, did an analysis in 210 subjects to test the resting mouth salivary flow rate and pH among tobacco chewers and smokers. Accordingly there was a decrease in the pH and flow rate in the both the groups. The tobacco chewers are more affected than the smokers.⁷ Shubha et al 2018 assessed the flow rate & pH of saliva in smoking and smokeless tobacco habits in subjects with lesions in a population of 628 subjects. There was significant reduction in the salivary flow rate and pH among the subjects. It also concluded that the alteration in salivary properties depends upon the duration and frequency of tobacco intake.⁸

From the results of our study in relation to the taste perception there is an alteration in perception of taste in both the study groups OSMF & Leukoplakia. The results revealed that the Bitter taste was most commonly altered in leukoplakia subjects followed by the salt and sweet taste. This was in accordance with the study done by Donald et al (1968), Nelly Jacob et al (2014), Krut et al and Fischer et al.

Donald et al 1968, did a research on smoking and taste perception. From the results of their study it was said that there is an initial dulling of taste for phenyl thiourea that is bitter taste perception immediately after smoking.¹⁰

Nelly Jacob et al 2014 stated that the oropharyngeal area is mostly affected from tobacco smoke. Leading to destruction of fungiform papilla thereby affecting the detecting threshold of taste. This was also in accordance with the study done by Konstantinidis et al in 2010. The combustion from cigarette smoking also causes an imbalance in papillary regeneration and gustatory function of saliva. So it is still uncertain whether it returns back to normalcy with cessation of tobacco smoking.¹¹

Many studies were conducted to see the relationship between taste perception among OSMF subjects. According to our study an increased percentage was seen in relation to Aguesia as most of the subjects was unable to identify the particular taste. Salt taste was the most commonly altered in our study followed by sweet, bitter and sour. This was in accordance with the following studies, Nitin Kumar Nigam et al 2013 in his study found a result of 38% altered taste perception in OSMF population.¹² Sujatha Dayasanoor et al 2016 did a study to find the alteration in salivary properties and taste perception among 45 OSMF subjects. The results of the study showed that there is a decrease in salivary properties with altered taste perception. The salt was most predominant altered taste followed by the bitter and sweet, indicating there is an increased atrophy of papilla in the anterior region of tongue.⁶

Monu Yadav et al 2017 in his clinic-biochemical study on alteration of taste perception among 60 OSMF subjects, also revealed that salt taste was most predominantly altered.¹³ Mekala et al 2019 in her evaluation on Gustatory function in OSMF population stated that as the severity of Grades increases in OSMF, statistical

significance is seen with the salt and sour taste. This study also showed that the salt and sweet taste sensation was most commonly altered.¹⁴

Conclusion

From the present study it can be concluded that there is a definite alteration in the quantity and quality of saliva due to usage of tobacco and other related products. A significant negative association is found between the salivary flow rate, pH and taste perception among the tobacco users in relation to normal people. On comparison of salivary properties like pH, flow rate and taste perception among OSMF and leukoplakia subjects the OSMF subjects are more prone for alterations.

Alterations in these salivary parameters could be an early sign of oral mucosal deterioration. Apart from the risk of malignancy, the loss of taste perception can lead to depression and anorexia in patients, affecting the quality of life, thereby these parameters should also be considered by the clinician during evaluation. Salivary characteristics like the pH, flow rate & taste perception can be made mandatory chair side investigation procedure among these patients. These investigations being completely non-invasive, inexpensive and time saving will definitely enhance patient management.

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