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Comparative Assessment of Salivary Flow Rate in Tobacco Users and Non-Users by Using Modified Schirmer Test and Volumetric Method

Ezhilarasi Arumugam Venkatachalam Sargurunathan[1], Durgadevi Pancharethinam*[2], Ramachandra Reddy Gowda Venkatesha[3], KarthikRajaram Mohan[4], Sabitha Gokulraj[5]

[1]Post Graduate Student, Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to Be University), Salem, India

[2*]Senior Lecturer,Department of Oral Medicine and Radiology, SreeBalaji Dental College and Hospital, BIHER, Chennai, India

[3]Professor, Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to Be University), Salem, India

[4]Associate Professor,Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to Be University), Salem, India

[5]Associate Professor,Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation (Deemed to Be University), Salem, India

***Corresponding Author:**

Durgadevi Pancharethinam

Senior Lecturer,Department of Oral Medicine and Radiology, SreeBalaji Dental College and Hospital, BIHER, Chennai, India

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ABSTRACT

Introduction;Saliva is an intricate bodily fluid with antifungal and antibacterial qualities that is vital to dental health and can be used as a non invasive tool in the diagnosis and prognosis of certain disease. Damage occurs in the oral cavity when salivary flow rate (SFR) decreases. Both smoke and smokeless tobacco use result in a decrease in SFR.

Aimand objectives: To estimate the unstimulated salivary flow rate in tobacco smokers, chewers and non users using modified Schirmer test (MST) and volumetric method and to determine the correlation between unstimulated salivary flow rate assessed using MST and volumetric

method. Materials and methods: The study population of 60 participants were divided into three groups.GroupA-20 smokers,GroupB-20 chewers, GroupC-20 Healthy individuals .The unstimulated salivary flow rate was measured using a modified Schirmer test for 3min and a volumetric method for 5 min.

Results: A significant positive correlation was observed between the SFR value obtained by the modified Schirmer test and the volumetric method (GROUP A p=0.008,GROUP B p=0.002). The salivary flow rate assessed using MST shows there was a decrease in salivary flow rate in smokers and chewers when compared to control group in 1st,2nd and third minute. **Conclusion:** Modified Schirmer Test (MST) can be used as an effective alternative non-invasive tool to estimate Salivary Flow Rate (SFR

Keywords: *MST, Salivary Flow Rate, Tobacco Users.*

1. INTRODUCTION

Saliva is a complex secretion produced inside the oral cavity, of which the major salivary glands secrete 93% and the minor glands the remaining 7%. Saliva is made up of 99% water and 1% each of organic and inorganic materials. The oral cavity is exposed to smokable and chewable forms of tobacco which has a definitive effect on salivary flow rate[(1),(2)]Tobacco can be taken in two ways: either smoked or smokeless, or in combination with areca nuts.[(3)].Long-term tobacco use negatively

impacts taste receptor sensitivity, which in turn reduces salivary reactivity. This could most likely cause abnormal responses from taste receptors, which would affect salivary flow rate.[4]Hypersalivation, also known as sialorrhea, is the objectively increased secretion of saliva, whereas hyposalivation is the objective reduction in salivary secretion. A subjective complaint of dry mouth that could be brought on by a reduction in salivary production is known as xerostomia.[5],[6]Hyposalivation, or impaired salivary secretion, raises the risk of oral infections such oral candidiasis and dental caries.[7]Saliva can be divided into two categories: total saliva and gland-specific saliva. Saliva from each of the parotid, submandibular, sublingual, and minor salivary glands can be directly collected to provide gland-specific saliva.[8] Whole saliva flow rates (SFR) during rest in healthy subjects have been observed to range between 0.3 and 0.5 ml/minute in a number of investigations.Up to 10 milliliters per minute may be the maximum rate of stimulated salivation. Oral health is significantly impacted by changes in SFR. [9], [10]

There are several techniques, including the suction method, the absorbent method, and the lashleys cup method, to quantify salivary secretion. Schirmer tear test strips, which are readily accessible commercially and are frequently used by ophthalmologists to detect tear gland function, are one novel alternative approach. It has been claimed that these strips are simple to employ in the oral cavity to identify people who have hyposalivation. MST is an easy-to-use, non-invasive chairside investigation that is economical and useful in our day-to-day work.[11][12],[13]In our study, modified Schirmer was used to estimate the quantitative salivary flow rate among tobacco smokers, tobacco chewers and non-users and was compared with the volumetric method

2. MATERIALS & METHODS

This clinical observational studywas carried out in the patients who reported to the Department of Oral Medicine and Radiology.The study was approved from the institutional ethics committee with Ref no VMSDC/IEC/Approval No:338. After taking thorough casehistory, clinical examinationwas carried out in 60 subjectsbetween age group 25 -50 yearsand informed consent was obtained from them. Study Design:Patients were divided into 3 groups: Group A: consists of 20 individuals with smoking habit Group B: consists of 20 individuals with tobacco chewing habit. Group C:consists of 20 individuals without any tobacco habit. The following individuals were excluded from the study: Patients with history of chemotherapy or radiotherapy, patients under medications like antidepressants, anti-cholinergic, antihypertensive and diuretic drugs, patients with systemic and salivary gland disorders and Patients who underwent surgery of salivary gland.

3. METHODOLOGY

Saliva collection was carried out between 9:00 am and 12:00 pm to avoid diurnal variation. Each subject was instructed to avoid any food/ drink/ tobacco 30 min prior and during the entire procedure.In Modified Schirmer Testa standardized commercially available Schirmer tear strip (STS) was used for the study calibrated in 1-mm intervals from 1-35mm. As the strip comes in contact with the saliva, there is absorption of saliva by capillary action which is indicated by the color change and is represented in blue colour.Before the conduct of the test, the patients were instructed to swallow all the saliva in their mouth & hold their tongue aganist their palate to prevent any contact with strip. The tip of the strip was then placed and positioned touching the floor of the mouth using a tweezer and the level of color change in the strip was recorded at time intervals of 1, 2 and 3 min. We did the same and adhered to the predetermined MST values based on the study analysis conducted by Chen et al. and Shruthi et al. In three minutes, a reading of less than 15 mm was classified as hyposalivation; in one minute, a reading of more than 15 mm was classified as normal salivation; and in one minute, a reading of 35 mm was classified as hypersalivation. Fig 1A& 1B. InVolumetric MethodUnstimulated Saliva was collected in the mouth for 5 minutes under resting condition was collected in a sterile graduated container.The SFR was measured and expressed in ml / min. The normal unstimulated SFR was 0.1 ml/ min or 0.5 ml/5min. Fig 2

Fig:1 (A) Placement of the strip in the floor of the mouth

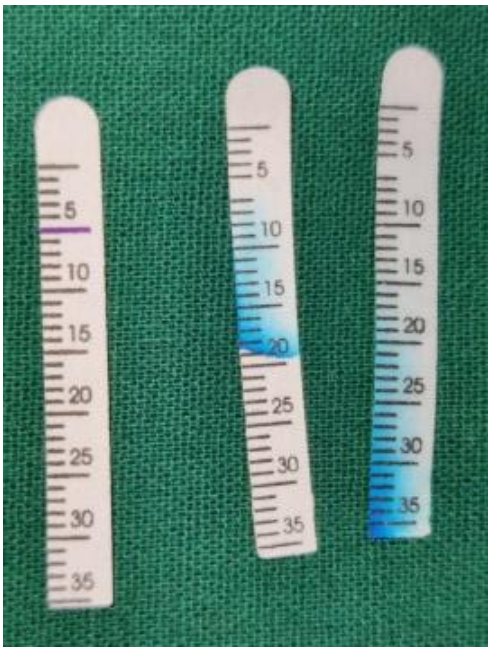


Fig:1 (B) Wetting of strip and level of color change.

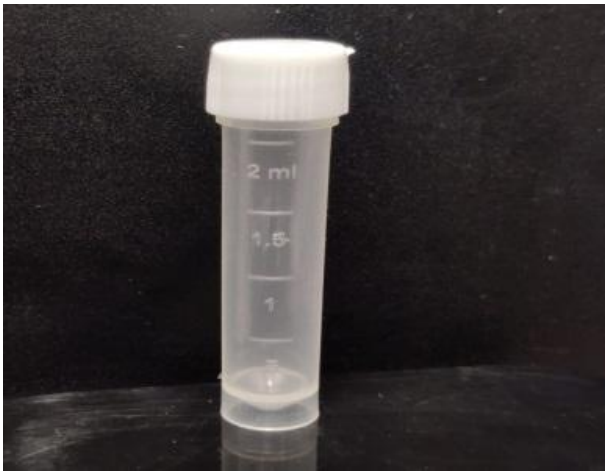


Fig: 2 Sterile graduated container

4. STATISTICAL ANALYSIS

The recorded data was compiled and entered into a spreadsheet computer program (Microsoft Excel) and it was then exported to the data editor page SPSS version 27 for statistical analysis. Standard deviation, averages, and percentages were calculated as part of the descriptive statistics. The ANOVA test was used to statistically determine the total number of patients, minimum age and maximum age, and estimated flow rate of saliva by the spitting method and MST. Pearson's correlation coefficient was applied to determine the correlation between the spitting method and MST. $P<0.05$ was considered statistically significant.

5. RESULT

Mean age distribution in groups (Table 1)showed group A had mean age of 32 with SD as 6;group B had mean age of 38 with SD as 9 and group c had mean age of 38 with SD as 8.Mean gender distribution (Table:2) showed Group A had 50% of male and 50% of female;Group B had 100%of male and 0% of female ;Group C had 95% of male and 5% of female. Salivary flow rate by volumetric method for 5 min(Table 3)showedsalivary flow rate was decreased in smokers and chewers when compared to control group and also the chewers had very less SFR comparing all three groups and the p value among all three groups was highly significant($p=0.00$). Assessment of salivary flow rate by MST in mm for 1,2 and 3 min(Table 4)showed all three groups had $p<0.001$ which was highly significant. MST values after 3 min in different study groups(Table:5)shows MST values (9-17mm) was obtained in 25% of smokers and 20% of chewers;MST values (18-26

mm) were obtained from 65% smokers and 80%of chewers ;MST values (27-35mm) values were obtained in 100% of control group and 10% of smokers. The comparison and correlation of salivary flow rate by volumetric method and MST(Table:6) shows the SFR value obtained from Group A by volumetric method at 5 min was 2.175 and by MST method was 32.35 at 3 min .pearson co-efficient value (r) was 0.4 with p value 0.08 which was not significant.Group B by volumetric method at 5 min was 1.115 and by MST was 20.15 at 3 min.pearson co-efficient value (r)was 0.578 with p value of 0.008 which was highly significant.Group C by the volumetric method was 1.07 at 5min and the MST method was 20.65 at 3min.pearson co-efficiamt value (r) value was 0.658 with a p value of 0.002 which was highly significant .

Table 1. Mean age distribution in groups

Group	Mean	SD	Maximum	Minimum
Control	32	6	44	25
Smoker	38	9	50	25
Chewer	38	8	50	25

Table 2. Mean gender distribution in groups

Group	Male		Female	
	N	%	N	%
Control	10	50.00%	10	50.00%
Smoker	20	100.00%	0	0.00%
Chewer	19	95.00%	1	5.00%

Table 3. Assessment of salivary flow rate by the volumetric method for 5min

Group	Mini	Max	Mean	SD	p-value
Control	1.5	2.5	2.175	0.311	0.000
Smoker	0.3	1.9	1.115	0.4771	
Chewer	0.3	1.7	1.07	0.4079	

Table 4. Assessment of salivary flow rate by the MST

	After 1 Min				After 2 Min				After 3 Min				
Group	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	p-value
Control	6	17	12.65	3.313	15	29	23.7	3.23	28	35	32.35	2.739	<0.001
Smoker	3	17	7.7	3.799	5	24	14.6	5.256	9	30	20.15	6.081	
Chewer	2	13	7.1	3.076	7	20	14.25	3.492	9	25	20.65	4.095	

Table 5. MST values after 3min in different study groups

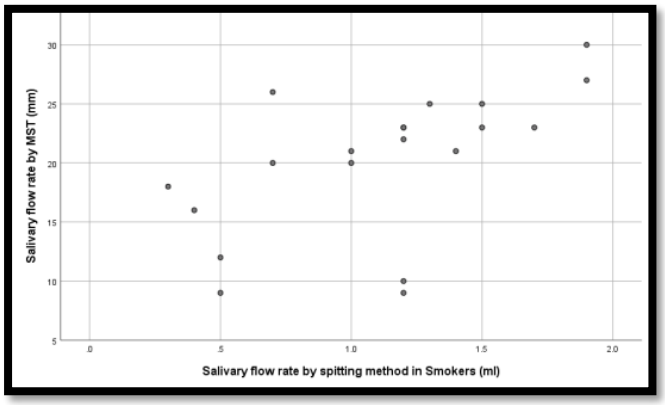
MST value	Control		Smoker		Chewer	
	N	%	N	%	N	%
9-17	0	0%	5	25%	4	20%

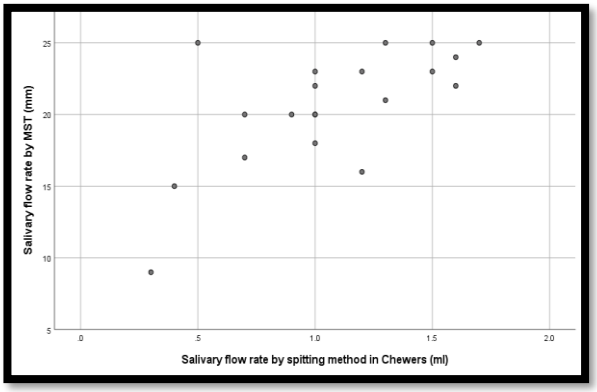
18-26	0	0%	13	65%	16	80%
27-35	20	100%	2	10%	0	0%

Table 6. Comparison and correlation of salivary flow rate by volumetric method and MST

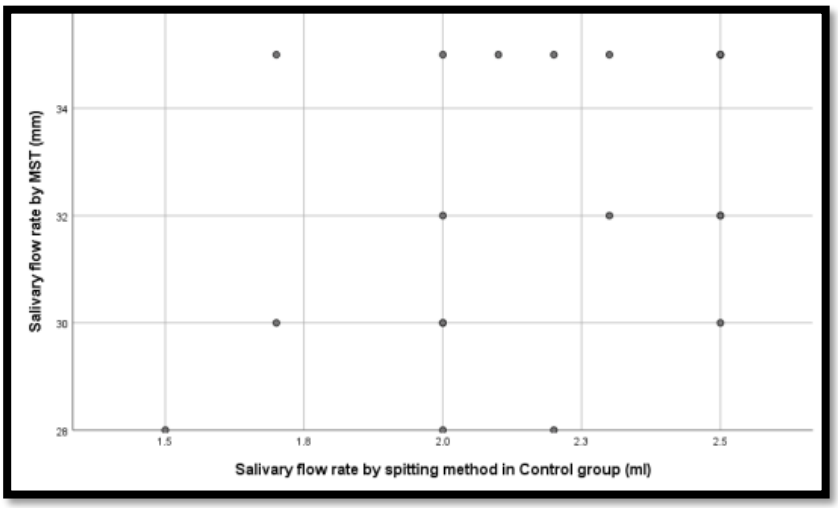
Group	Volumetric method(5min-ml) (Mean)	MST(3min_mm) (Mean)	Pearson Coefficient(r)	p-value
Control	2.175	32.35	0.4	0.08
Smoker	1.115	20.15	.578**	0.008
Chewer	1.07	20.65	.658**	0.002

GROUP-A **GROUP-B**

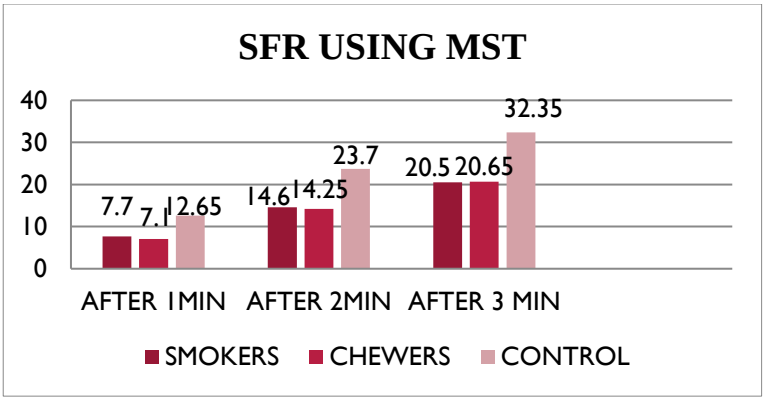




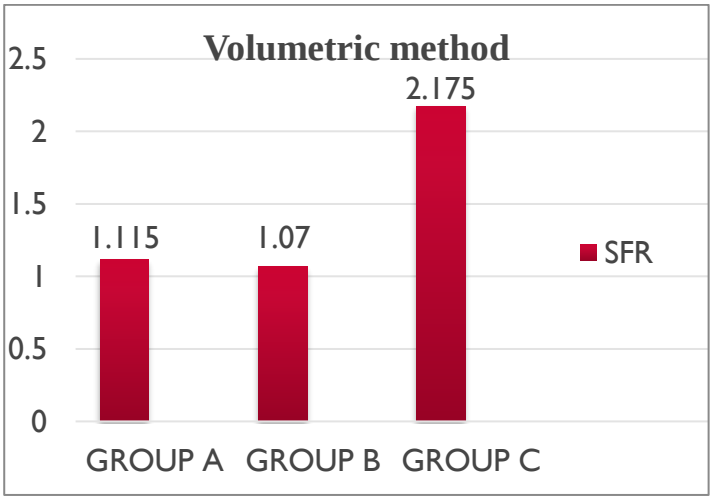
GROUP-C



3. Comparison and correlation of SFR by the spitting method and MST in group A(smokers),groupB(chewers),group C(control)



Graph 1: MST values after 3min in different study groups



Graph 2:Assessment of salivary flow rate by the volumetric method measured in ml for 5min

6. DISCUSSION

Saliva is a diverse fluid that continuously coats the teeth and oral mucosa. It contains proteins, glycoproteins, electrolytes, tiny chemical molecules, and substances carried from the blood. Along with gingival fluid, whole saliva is a combination of secretions from major to minor salivary glands.[14]Salivary gland hypofunction causes a considerable reduction in both stimulated and unstimulated salivary flow. It can also lead to changes in the chemical makeup of saliva. It is commonly characterized as less than 0.1–0.2 mL/min for unstimulated whole saliva and less than 0.7 mL/min for stimulated whole saliva.[15]Nitrosamines are the most important by-products of tobacco that affect the oral cavity which determines the salivary flow rate. Tobacco can be taken in two ways: either smoked or smokeless, or in combination with areca nuts.[3],[16]Long-term tobacco use is thought to reduce taste receptor sensitivity, which in turn reduces the salivary reflex. It is suggested that prolonged tobacco use may modify the responsiveness of taste receptors, altering the SFR. Many oral alterations and disorders are largely caused by unstimulated whole mouth salivary pH and SFR.[17]In our study salivary flow rate was assessed and compared among tobacco smokers, chewers and non-users by using Modified Schirmer test and volumetric method. The salivary flow rate assessed using MST showed a decrease in salivary flow rate in smokers and chewers when compared to control group in 1st,2nd and third minute with a statistical significance of ($p<0.001$).MST value obtained at third minute showed smoker group had mean SFR 20.15, chewer group had SFR 20.65and control group had 32.35.

The results of volumetric method also showed highly significant values ($p=0.00$).The mean salivary flow rate values obtained by volumetric method in smoker group was 1.115,chewer group 1.07 and control group2.175.There was a decrease in salivary flow rate in tobacco users when compared to subjects without any tobacco habits. Alpana Kanwar et al conducted a study among tobacco smokers, chewers and non-users and there was a significant decrease in saliva flow rate of tobacco users when compared to non-users which was consensus with our study.[18] Maryam Rad et al 2010, Sujatha Dyasanoor et al 2014 conducted study among smokers and non-smokers. There was a significant decrease in salivary flow rate in smokers when compared to non-smokers. Their findings were also consistent with our study.[19],[20]MST value 9-7mm value was obtained by 25% of smokers and 20% of chewers ,18-26 mm value was obtained by 65% of smokers and 80% of chewers and the value 27-35 mm was obtained by 10% of smokers and 100% of control group .Chen et al pointed out that the MST value <

15 mm at 3 min suggested severe xerostomia and hyposalivation of patients after head or neck radiotherapy.[21] Non-xerostomic healthy subjects had a mean reading of approximately 30 mm at three minutes. According to Fontana, the modified Schirmer test value < 25 mm at 3 min suggests hyposalivation with high sensitivity (77%) and specificity (80%).[22]The comparison and correlation of salivary flow rate obtained by MST and volumetric method shows positive correlation between MST and volumetric method in smokers group(p=0.008) and chewers group(p=0.002) and no correlation in control group. The strip would reach the 35 mm marking before 3 min, and lack of standardization might be the reason for control group not obtaining significant results. The study conducted by Chen et al, Shruthi et al also showed non-significant values in control group. In our study there was a strong correlation between MST and volumetric method which was in concordance with a study by Kumar et al, Shruthi et al. where MST was used to check hyposalivation in patients on antidepressants and evaluated the relationship between the MST and volumetric methods and found that there was an association between the MST and volumetric/gravimetric methods.[5],[23]

7. CONCLUSION

There was a decrease in salivary flow rate in tobacco users when compared to subjects without any tobacco habits. A significant positive correlation was observed between the SFR value obtained by both the modified schirmer test and volumetric method. At the denouement of our study, we conclude that MST technique can also be used as an alternate to the volumetric method and other methods in analyzing SFR and will be more expedient in bed ridden, geriatrics, paralyzed, specially abled patients

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