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ORIGINAL ARTICLE

Efficacy of Transcutaneous Electric Nerve Stimulation (TENS) Therapy on Salivary Flow Rate

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ABSTRACT

Saliva is a complex and critical fluid; its important role is to maintain the Homeostasis of oral cavity. Hyposalivation refers to a decrease in salivary flow rate which is common sequelae in patients undergoing irradiation of malignant tumors of the head and neck and also uses of medications such as antihistamines, anticonvulsants, anti-hypertensives, diuretics, sedatives, and anxiolytics, etc. Transcutaneous electrical nerve stimulation (TENS) is a well-known therapy, used to treat pain and can increase the flow rate of saliva. The study aimed to evaluate the implications of TENS therapy and its repercussions on salivary flow rate. The study resulted in increased salivary flow in majority of the cases considered in the study.

KEY WORDS : TENS, Salivary glands, salivary flow, stimulated saliva, parotid saliva

INTRODUCTION

Saliva is a complex and critical fluid; its important role is to maintain the Homeostasis of oral cavity (Vilas *et al.*, 2009). There are three major salivary glands (parotid, submandibular, and sublingual), along with 300-500 minor salivary glands, which produce about 1.5 litres of the whole saliva daily.[2,3] Resting saliva is primarily secreted by the submandibular glands (approximately 65%); in contrast, stimulated high flow rates drastically change percentage contributions from each gland, with parotid contributing more than 50% of the total salivary secretions (Vilas *et al.*, 2009). and also there is variability in individual salivary flow rates (Vilas *et al.*, 2009).

Saliva plays a major role in maintaining enamel mineralization. It usually contains IgA thus it plays a major role in oral immunology (Hargitai *et al.,* 2005). it contains amylase, thereby initiating carbohydrate digestion. It also possesses some antibacterial enzymes such as lysozyme, histatins, and lactoferrin (Atkinson & Wu, 1994; Mandel, 1993).

Ptyalism and Hyposalivation are the two important factors that should be known. Ptyalism refers to excessive salivary flow rate. Hyposalivation refers to a decrease in salivary flow rate which is common sequelae in patients undergoing irradiation of malignant tumors of the head and neck and also uses of medications such as anti-histamines, anticonvulsants, anti-hypertensives, diuretics, sedatives, and anxiolytics, etc; although systemic agents like pilocarpine and cevimeline stimulate salivary flow, often have unfavorable side effects such as profuse sweating, rhinitis, and dyspepsia. Decreased saliva-xerostomia may result in rampant caries, increased plaque formation, opportunistic fungal infections, mucositis, difficulty swallowing, and difficulty in eating malnourishment, and oral pain. Palliative management of xerostomia includes topical agents such as ice chips and saliva substitutes. Other measures include increasing water intake, applying lip balm, chewing sugar-free gum, or sucking sour, sugar-free lemon drops.

Transcutaneous electrical nerve stimulation (TENS) is a well-known therapy, which is used to treat pain. Some Studies shown electrostimulation can increase flow rate of saliva. However, it never became a part of mainstream therapy. Results of recent preliminary investigations of

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noninvasive electronic stimulation of reflex salivation in xerostomic patients have been encouraging (Weiss *et al.,* 1986; Steller *et al.,* 1988). Research in this area has been sparse and, hence, this study was undertaken to evaluate the effect of TENS on the whole salivary flow rate in healthy, adult subjects and to compare the flow rate between the unstimulated saliva and saliva stimulated with TENS (Vilas *et al.*, 2009).

Aim: To assess the salivary flow rate before and after TENS application

Objective: To evaluate the Transcutaneous Electric Nerve Stimulation(TENS) therapy efficacy on salivary stimulation in healthy adults

MATERIALS AND METHODS

The study was approved and consent granted by the Institutional Ethics Commitee (IEC) at the Anil Neerukonda Institute of Dental Sciences (ANIDS), Sangivalasa, Visakhapatnam. Fifty subjects who are healthy adults (25 Males, 25 Females, 19-55years of old, and mean age of 37) are enrolled from the patients visiting the Department of Oral Medicine and Radiology, ANIDS, with no history of systemic disease or under any medication and no history of salivary gland disorder, were included in the study. The subjects served as their control. Written informed consent was obtained from all participants. Exclusion criteria included patients under age 18 years and those persons with cardiac pacemakers, having autoimmune diseases, with pregnancy, having a history of salivary gland pathology and those under any medications which include Xerostomia like antihistamines, antidepressants, antipsychotics, Angiotensin-converting enzyme inhibitors, calcium channel blockers, beta-blockers etc.

Fig. 1. TENS instrument UltraCare PRO's TENS 1.0

The TENS used in this study is UltraCare PRO's TENS 1.0 and Graduated Tubes

The electrode pads were placed externally on the skin overlying the parotid glands with the TENS units in the "off" position. Unstimulated saliva was collected for 5 mins into tubes. The TENS unit was then activated and the intensity control switch adjusted for patient comfort. Intensity was turned up 1 increment at a time at 5-second intervals until the subject indicated by raising their hand that an optimal intensity level was reached.

A paired t-test was applied to look for statistically significant differences as a group between the amount of unstimulated and TENS-stimulated samples of saliva.An independent samples t-test, evaluating mean charges in stimulated versus unstimulated salivary flow rates,was applied to look for statistically significant differences with respect to gender,one wayanova was used for multiple groups comparison

RESULTS

43 out of 50 subjects showed an increase in salivary flow rate.

Fig. 2. (a) Collecting the unstimulated saliva; (b) Activation of TENS upto optimum intensity level of the patient; (c) Tubes showing unstimulated and stimulated saliva.

Oneway

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ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Variable 1	Between Groups	1.620	1	1.620	2.081	.156
	Within Groups	37.360	48	.778		
	Total	38.980	49			
Variable 2	Between Groups	18.000	1	18.000	10.898	.002
	Within Groups	79.280	48	1.652		
	Total	97.280	49			

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T-Test

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Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Variable1	1.980	50	.8919	.1261
	Variable2	3.880	50	1.4090	.1993

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Variable1 & Variable2	50	.583	.000

Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
					Lower	
Pair 1	variable1 - variable2	-1.9000	1.1473	.1623	-2.2261	

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	variable1 - variable2	-1.5739	-11.710	49	.000

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MEANS

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Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
variable1* GENDER	50	100.0%	0	0.0%	50	100.0%
variable2* GENDER	50	100.0%	0	0.0%	50	100.0%

Report

GENDER		variable1	variable2
1.0	Mean	2.160	4.480
	N	25	25
	Std. Deviation	.8981	1.3577
2.0	Mean	1.800	3.280
	N	25	25
	Std. Deviation	.8660	1.2083
Total	Mean	1.980	3.880
	N	50	50
	Std. Deviation	.8919	1.4090

Table 1: Comparative tabulation depicting Salivary flow before and after TENS treatment.

	Mean	Std. Deviation	Test statistics	P value
Saliva before TENS treatment	1.9800	.89191	-5.725	0.000*
Saliva after TENS treatment	3.8800	1.40901		

*statistically significant, Wilcoxon Signed Ranks Test

Table 2: Independent t-test comparing different study groups.

	group	N	Mean	Std. Deviation	Std. Error Mean
before	1	26	2.12	.909	.178
	2	24	1.88	.900	.184
after	1	26	4.46	1.392	.273
	2	24	3.29	1.233	.252

Table 3: Independent t-test showing the increase in salivary flow in males when compared to females.

Variable	Male	Female	*p-value*
before	2.12 ± 0.90	1.88 ±0.90	0.35
after	4.46 ± 1.39	3.29 ± 1.23	0.003

DISCUSSION

It has been known that the nerves in the salivary glands control the secretion of saliva.Saliva secretion is normally controlled by reflex stimulation with effector nerve impulses travelling along the sympathetic as well as parasympathetic nerves to the glands (Vilas *et al.*, 2009).

Transcutaneous electrical nerve stimulation(TENS) has been evaluated in stimulating salivary flow and it was found to be effective even in patients with xerostomia secondary to radiation therapy for head and neck cancer. However these studies are very few therefore,the present study was conducted to evaluate the efficacy of TENS therapy in healthy adult subjects (Vilas, *et al.*, 2009).

The investigation aimed to determine the variation of salivary flow rate in healthy adults.50 subjects were taken under the study *i.e.,* 25 males and 25 females,where 43 members have shown increased salivary flow rate.

There was no increase in salivary flow in 7 subjects. In a previous study, Hargitai *et al*. (2005) observed that TENS was unable to stimulate the parotid saliva and it

was interpreted that TENS may act more efficiently as an accelerator of salivary flow rather than an initiator. It could be due to the patients' physical and mental condition at the time of collection of saliva.

In our study, the stimulated salivary flow rate was higherfor males than for females.The gender difference in salivary flow rate was similar to that observed in previous studies. Thorselius *et al*. stated that the reason for the lower salivary rate in women was that they had smaller salivary glands. Ghezzi *et al*. presented that there were no significant age and gender differences in the salivary flow rates.

The only side effect of the TENS therapy seen in our study was mild twitching of facial musculature,also described by Hargitai *et al*. (2005). It was minimal and transient and ceased immediately after the TENS unit was switched off.

The mechanism by which the TENS unit worked on parotid gland may be that it directly stimulates the auriculotemporal nerve that supplies secretomotor drive to the parotid gland (Vilas *et al.*, 2009).

The main advantage offered by TENS over other non-pharmacological methods such as chewing gum or citric lozenges is that it is an extraoral device with minimal side effects.It can also be used while eating food and it doesn't affect the normal mastication process.So it is beneficial than intraoral devices.Artificial saliva preparations can be used but they have some limitations.

There are very few studies to show TENS for an increase in the salivary flow. In our study, the effect of TENS is effective in stimulating the parotid saliva. In normal,healthy subjects.

CONCLUSION

TENS is an effective means for stimulating saliva with very few transient side effects. Further research of this modality in the stimulation of salivary flow is required to determine its role in the treatment of xerostomic patients secondary to various local and systemic causes.The encouraging results of present study indicate TENS has the potential to increase salivary flow and can be a viable alternative in the management of xerostomia.

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