



## Effectiveness of transcutaneous electrical nerve stimulation on improving hyposalivation in xerostomia patients with diabetes mellitus

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### Abstract

The aim of the study is to analyse the effectiveness of TENS [transcutaneous electrical nerve stimulation] on improving hyposalivation in Xerostomia patients with diabetes mellitus. This was an experimental study with pre and post-test type. Sixty (60) Diabetes mellitus patients with hyposalivation condition were treated with TENS on their external surface of salivary glands and other corresponding buccal nerves. The duration of the treatment is for 15-20 minutes 1 session per day four sessions a week for 4 weeks. A simplified questionnaire is used as a screening tool and Sialometry method is used to analyze the saliva secretion. Saliva samples were collected from the subjects prior to TENS stimulation. The present study states that, the salivary secretion was increased after TENS application in continuous mode ( $p < 0.001$ ) and burst mode ( $p < 0.001$ ). It was illustrated when compared to saliva taken before therapy, particularly in xerostomic diabetes mellitus patients.

**Keywords:** Saliva; Diabetes mellitus; Hyposalivation; Xerostomia; TENS; Salivary glands

### Introduction

Xerostomia is the term used to describe the subjective sensation of a dry mouth (Sivaramakrishnan and Sridaran, 2017). It is the most prevalent long-term concern for the majority of individuals with diabetes (Chandra *et al.* 2022). According to the World Health Organisation, dry mouth which is also known as xerostomia which occurs when the salivary glands in the mouth fail to produce sufficient saliva, resulting in mouth dryness. (Sivaramakrishnan and Sridaran, 2017). Xerostomia and hyposalivation are two distinct and independent phenomena that can manifest alone or in combination (Paim *et al.* 2019). Dry mouth is occasionally, but not always, accompanied by a decrease in salivary flow (Bhasin *et al.* 2015). Dry mouth can be caused by a variety of factors, with

long-term xerostomia being especially prevalent in Sjogren's syndrome and following radiotherapy to the head and neck (Chandra *et al.* 2022). Xerostomia is a rule overseen with saliva replacements, however, there is an abundance of potential systemic treatments for long-term xerostomia currently available.

Although SGH (salivary gland hypofunction) can have a significant influence on a patient's oral health and quality of life, xerostomia can also have a significant impact (Bhasin *et al.* 2015). Halitosis, oral discomfort and burning, fissuring of the tongue, xerostomia, characterized by symptoms such as dryness or a sensation of stickiness in the mouth, thick and stringy saliva, bad breath,

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difficulty in chewing, speaking, and swallowing, a dry or sore throat, hoarseness, and a dry or grooved tongue, can also lead to issues with wearing dentures due to a modified perception of taste (Bhasin *et al.* 2015). Extraoral discoveries incorporate dry and broken lips, which may be tainted with *Candida*, and sometimes extended salivary organs. There are an assortment of salivary and no salivary causes of xerostomia, the foremost visit being pharmaceutical side impacts and systemic clutters (Lakshmanan *et al.* 2015). Epidemiological ponders of dry mouth circumstances from the final two decades have appeared predominance gauges extending from 1% to 62%. The high changeability in estimate has been ascribed to varieties in estimation strategies, populaces examined, test representativeness, ponder plan, and the age of people assessed (Salimi *et al.* 2021).

The evaluated worldwide prevalence of dry mouth was calculated utilizing fixed- and random-effect models (Salimi *et al.* 2021). Females had a substantially higher prevalence of xerostomia (19.51%) than males (11.91%) ( $p=0.001$ ). The three most prevailing causes of hypo salivation are medicines, persistent uneasiness or misery, and lack of hydration. A few drugs that cause dry mouth are medicines for sinusitis, tall blood weight (such as “water pills”), uneasiness and misery, psychiatric clutter, or a hyperactive bladder (Mehanna *et al.* 2016). Psychological disorders (57.14%) had the highest prevalence of xerostomia, At the forefront is diabetes mellitus (53.84%) trailed by range of neurological disorders (40%), thyroid complications (37.5%), and hypertension (36.48%) following the suit (Pinna *et al.* 2015).

Dry mouth often becomes a prevalent concern among the aging population. Contributing variables include specific solutions, modifications in the body’s aptitude to prepare medication, a lack of nourishment, and chronic medical conditions.

Chemotherapy medications can modify the composition of saliva and its production quantity (Rodin *et al.* 2018). This could be short, with standard rate of salivary flow resuming after treatment is finished. Radiotherapy treats the craniofacial could impairment to salivary organs, resulting in decline in salivary fluid output. Contingent upon the radiation measures and region treated, this could be transient or long-lasting. (Cheng *et al.* 2011).

Dry mouth may ensue as a consequences of nerve damage resulting from head and neck injuries or surgical procedures. Dry mouth can be caused by specific health disorders. Dry mouth can be attributed to various condition including diabetes, stroke, oral thrush (yeast infection in the mouth) and or

by immune system ailments, such as Sjogren's syndrome or HIV/AIDS. Wheezing and breathing with your mouth open can also contribute to dry mouth (Furness *et al.* 2013). Drinking alcoholic beverages and smoking or chewing tobacco might exacerbate dry mouth symptoms. Use of recreational drugs. methamphetamine usage can cause significant dry mouth and tooth damage, a condition known as "meth mouth." Cannabis, like other drugs, can produce dry mouth (Bhasin *et al.* 2015).

Xerostomia causes tooth decay, infection, and psychological distress. Salivary replacements and pharmaceutical medicines have only provided brief comfort. Several researchers have considered using transcutaneous electrical nerve stimulation (TENS) to treat xerostomia (Hoyne *et al.* 2017).

Sialometry enables the evaluation of the functions of each gland (Kakoei *et al.* 2012). Salivary stream rates can be measured (Sialometry). Resting saliva can be collected by inquiring the understanding to dribble into a measuring holder for 3-5 minutes (Grundmann *et al.* 2009). The utilitarian action of the salivary organs is carried out on the premise of the collection of blended saliva of verbal depth. They judge the full secretion of all organs, without taking into consideration the commitment to the full sum of salivation of each organ. The TENS unit was then activated and treated. The process of amassing saliva samples was initiated for another five minutes. The paired t-test is the test for contrasts between two bunches on a single try. This test requires two autonomously collected tested bunches, contrast on a single continuous variable.

## Materials and methods

This was an experimental study with a pre and post-design that took about 3 months to complete. When the institutional review board granted its consent to the study. NO: B-19/Physio/IRB/2021-2022, 60 subjects were selected from 75 volunteers depending on inclusion and exclusion criteria. Participants in the study ranged in age from 30 to 60 years with chief complaints of hypo salivation with diabetes mellitus they were enquired with a xerostomia questionnaire and then saliva samples were collected before the TENS stimulation.

The patients with diabetes mellitus associated with hypo salivation are treated with TENS on the salivary glands. The transcutaneous electrical nerve stimulation (TENS) on the salivary glands helps to augment the production the saliva in the mouth and also prevents xerostomia in the early stage. This study is to observe changes in the subject’s salivary production and to analyze the secretion improvement.

All members experienced a starting clinical assessment. The clinical appraisal included verbal inspection, appearance of verbal mucosa, nearness of dryness and splits, or hyperemia. To characterize the test, patients were also inquired about certain addresses which are said within the questionnaire connected below.

A free evaluator who was dazzled to gather allocation assessed SSF (treated salivary flow) through the sialometry technique. All measurements were taken in the morning to maintain a strategic distance from the impact of circadian oscillations.

A total of 60 communal subjects were randomly included in the study. The samples were collected before the TENS stimulation as a pretest sample and after the treatment, post-test samples were collected.

Before taking saliva samples from the individuals, they were advised not to eat, drink, smoke, or use chewing gum.

steadily increased to the highest tolerated level for each patient.

Sialometry, which involves collecting saliva and measuring the amount of discharge produced per minute, is used to assess hypo salivation. The determination of hyposalivation is critical because the disorder can have a detrimental impact on daily activities and quality of life.

### Results and discussion

Distribution of the study members concerning sex, duration of diabetes, and hyposalivation are demonstrated in table I. Xerostomia a sensation of hyposalivation was present in 60% of the members. The prevalence of xerostomia was 13% among ladies and 6.1% among men. In any case, there was no measurable affiliation between the presence of a structural malady and xerostomia.

The mean age was 45-49 as per the demographic analysis a

**Table I. Descriptive data on the participants' demographic characteristics**

Variables	N	Minimum	Maximum	Mean	Std. Deviation	Statistic	Skewness Std. Error
AGE (Overall)	60	30.00	60.00	48.93	9.85	-.387	.580
MALE	32	36.00	60.00	49.40	9.07	-.191	.583
FEMALE	28	30.00	60.00	49.16	9.31	-.292	.427

Individual was made to sit erect, comfortably, with the head inclined forward.

Only a reduced rate of secretion of untreated whole saliva is right now considered to be of diagnostic value in SS (salivary secretion). The patients were instructed to swallow their saliva and remain still so that the saliva could be collected resting unobtrusively in the front section of the mouth's lower surface. Placed serenely in the anterior region of the oral cavity's floor. The untreated saliva was passively collected for 5 minutes in a graduated measuring cylinder connected with a funnel using sialometry (passive drooling method). TENS terminals were put in after 5 minutes of total saliva collection.

The electrodes were placed externally on the skin above the parotid glands, with the TENS unit turned off. It was then turned on, with the pulse rate set at 50Hz and the intensity

few participants had controlled diabetes and others uncontrolled diabetes. Of 60 subjects of diabetes mellitus, 50 participants had xerostomia and the other 10 participants had the symptoms of hyposalivation.

Table II shows the frequency distribution of the screening tool for hyposalivation in xerostomia patients with diabetes mellitus. All the participants were asked to take a survey based on salivary flow and oral health.

The mean, standard deviation (S.D), t-value, and p-value between the pre-test and post-test within the group are revealed in table III. Within Bunch, there is a truly significant difference between pre-test and post-test data ( $p \leq 0.001$ ).

**Table II. Frequency distribution of screening tool for hyposalivation**

Sl.No	Scale	Yes	No
1.	During meals, you experience dry mouth.	66.6%	33.4%
2.	Have difficulty swallowing food	63.3%	36.7%
3.	Most of the time, you feel only a small amount of saliva in your mouth.	83.3%	16.7%
4.	A feeling of dry mouth during the night or upon waking	66.6%	33.4%
5.	During the day, you may experience dry mouth.	50%	50%
6.	Chew gum or mints to alleviate dry mouth symptoms.	33.4%	66.6%
7.	wake up thirsty frequently at night	83.3%	16.7%
8.	Experiencing a burning feeling on your tongue.	26.6%	73.4%

**Table III. Comparison of saliva collection amount within group between pre and post test values**

Test	Pre Test		Post Test		t - Test	Significance
	M	S.D	M	S.D		
Group	0.265	0.089	0.341	0.320	-1.25	0.001***

The mean, standard deviation (S.D), t-value, and p-value between pre-test and post-test within Group are shown in the table above.

Within Group, there is a statistically significant difference between before and post test data ( $p \leq 0.001$ ).

The purpose of the study was to determine the efficacy of TENS in treating hypo salivation in xerostomia patients with diabetes mellitus. Dry mouth, also known as xerostomia, is one of the most prevalent long-term consequences of diabetes mellitus, and it has a significant impact on quality of life. In these cases, transcutaneous electrical nerve stimulation could be a novel technique for pushing forward the saliva stream.

Sixty subjects with chief complaints of hypo salivation with diabetes mellitus of age between 30-60 years were included as per the inclusion criteria and the patient completed the oral health questionnaire which is used as a screening tool for the analysis. The patient was also asked to perform the passive drooling test (PDT) as a pre-test to collect the saliva samples. It was deliberated both pre and post application of TENS.

According to the findings of this study, TENS significantly improved the salivary flow of individuals with diabetes mellitus and hyposalivation. A critical finding was a direct positive link between the intensity of the associated electrical stimulation and salivary stream reactivity.

The collected data appears four weeks convention on xerostomia patients with diabetes mellitus. Age alone was found to be a calculated related to xerostomia for each one-year increment, the chance of having xerostomia expanded 1.01 times ( $p \leq 0.001$ ) guys were found to have a 1.56 times smaller chance of ( $p < 0.012$ ).

Dry mouth is an intricate disorder that will become more prevalent as the population ages. Much research has been

conducted to examine and comprehend the reason for dry mouth. Its influence on patients is relevant to its detrimental impact (Tschiesner *et al.* 2013). The changing ways of life, increment in stretch and uneasiness, sort II DM, and dry mouth are rising as a plague condition. Incite determination hence, helps in early intervention to reduce indications in both reparable and nondurable conditions contributing to dry mouth. Being aware of the causes and clinical introduction makes a difference in verbal medication masters to treat this condition at an early organize, hence stopping advanced complications (Shea *et al.* 2017).

The xerostomia questionnaire performed well as a screening tool for cases of hyposalivation. The questionnaire examined can be used as an epidemiological screening tool to identify hyposalivation instances. If the questionnaire findings are positive the subject should be submitted for tests to confirm the diagnosis (Wong *et al.* 2015). According to (Sivaramakrishnan and Sridaran, 2017)., significance of evidence is inconsequential in the use of TENS in individuals with xerostomia and may be considered as a salivary alternative for clinical relief. However, the current type, frequency, and amplitude must be thoroughly investigated. To support or reject the use of TENS in xerostomia, high-quality randomized controlled trials with acceptable power are necessary (Vijayan *et al.* 2014). According to Lakshman *et al.* (2015), the study provided insight into the efficiency of TENS therapy in boosting salivary flow in healthy people and it is particularly beneficial when used in conjunction with radiation therapy by minimizing radiation therapy's adverse effects. As a result, TENS therapy can be utilized in conjunction with other therapeutic methods to treat xerostomia (Dyasnoor *et al.* 2017).

The percentage of times the questionnaire accurately identified persons with and without hyposalivation was used to calculate the test's accuracy. Using diagnostic precision measures, the questionnaire ratings were compared to the salivary flow rates. The questionnaire results suggest that more people have a feeling of xerostomia. (Swick and Kimple, 2014).

According to the study's findings, a significant difference between pre-test and post-test salivary sample before and after TENS treatment in continuous mode ( $p < 0.001$ ) was demonstrated when compared to untreated saliva, particularly in xerostomic diabetic patients. The burst mode resulted in a statistically significant decrease in salivary flow ( $p < 0.001$ ).

## Conclusion

The study concludes that transcutaneous electrical nerve stimulation can be used safely in the rehabilitation of xerostomia and hyposalivation for patients with diabetes.

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