Electrostimulation AND XEROSTOMIA

by Dr. Andy Wolff

Dr. Andy Wolff, a dentist and specialist in oral medicine, graduated in 1981 from the University of Tel Aviv, Israel, and revalidated his degree at the University of Buenos Aires, Argentina. Wolff has been director of several public dental clinics in Israel, guest researcher at the U.S. National Institutes of Health, director of the saliva clinic at Tel Aviv University, and director of the Department of Dentistry at Assuta Hospital in Tel Aviv. He has been awarded seven research grants from the European Commission budgeted in millions of euros to develop medical devices. He has authored more than 75 publications in scientific journals and five chapters in books. Wolff was the head of the group "Medication-induced salivary gland dysfunction" of the World Workshop on Oral Medicine, sponsored by the American Academy of Oral Medicine and the European Association of Oral Medicine.

Xerostomia is defined as the sensation of oral dryness and is often a symptomatic manifestation of hyposalivation. Xerostomia may indicate the presence of alterations in the function of the salivary glands and an elevated risk of oral complications. Symptoms and consequences associated with hyposalivation include difficulties in speech, swallowing and tasting, and a significant increase in the rate of dental caries and other oral infections.

Although hyposalivation can be caused by a variety of conditions (head and neck radiation, Sjögren's syndrome, medications, etc.), its main symptom, xerostomia, is common to all these disorders and only varies in intensity. Therefore, the treatment is not specific, and therapeutic management is similar in all cases, regardless of the cause of xerostomia. Traditional modes of treatment include oral palliative care (saliva substitutes, mouthwashes or gels) and salivary flow stimulants (pharmaceutical or taste products).

ELECTROSTIMULATION

Lately, electrostimulation has been added to the available therapeutic arsenal. The rationale behind it is that electrostimulation can simulate, at least partially, the normal physiologic mechanism of salivary gland stimulation.

Salivary gland secretion is controlled by the autonomic nervous system, in particular by the parasympathetic nervous system through the salivary reflex arch, which consists of three major components:

1. Afferent nerve fibers (going from the periphery to the brain) carrying impulses induced by:
   - **Chemical/gustatory stimulation,** such as tasting food, conveyed by fibers included firstly in the lingual branch, and then in the facial nerve.
   - **Mechanical stimulation,** such as chewing food, tactile perception of foreign bodies in the mouth, or movements of oral muscles such as the tongue.
   - **Stimuli coming from other areas of the body,** such as smelling food.
2. A central connecting and processing center (salivary center in the brain), into which the impulses above are conveyed by the relevant nerves, in particular the facial nerve.
3. Efferent nerve fibers (going from the salivation center to the salivary glands) that carry the imparted secretory command to the parotid glands by the auriculo–temporal nerve; to the submandibular, sublingual and several minor salivary glands by the lingual nerve; and to the remaining minor salivary glands by other nerves.

Currently, two methods of electrostimulation of salivation are available: extraoral and intraoral. As to the former, human experiments have shown that the application of an electric current on the skin, in the area of the parotid gland increases parotid salivary secretion by stimulating the efferent fibers of the auriculo-temporal nerve.[1]

It has also been demonstrated that application of electrical stimulation to the mucosa on the lingual side of the lower third molar area increases overall salivation and improves dry mouth symptoms. This effect is achieved due to the excitation of both:

- The efferent fibers of the lingual nerve that will later reach and stimulate the submandibular and sublingual glands and also several minor salivary glands.
- The afferent fibers of the lingual nerve that reach the salivary center in the brain and, by doing so, the electrostimulation potentiates the salivation reflex, evoking an increase in the secretion of all the salivary glands (Fig. 1).[2]

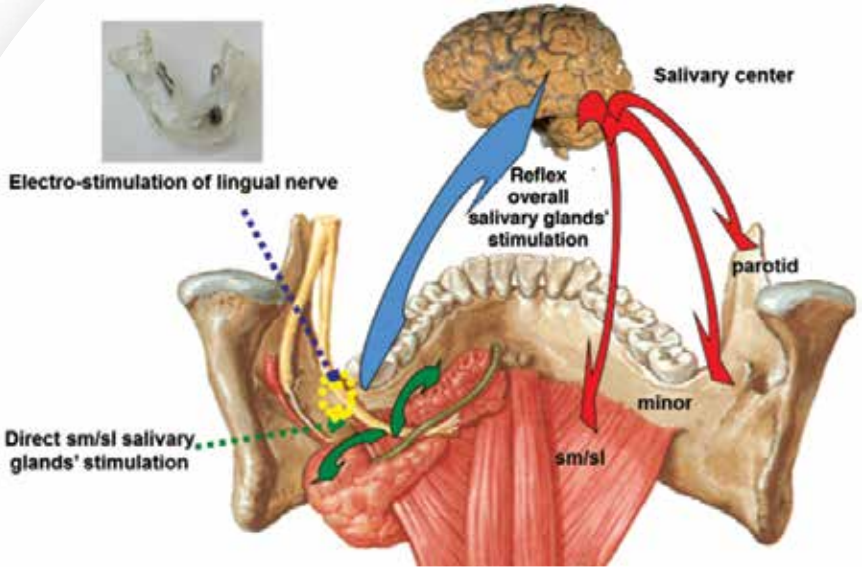

Fig. 1: *The site of lingual nerve electrostimulation, lingually to the third molar location, is shown by the dotted yellow circle. The green arrows represent the stimulation conveyed by efferent fibers to the submandibular (SM) and sublingual (SL) glands. The blue arrow indicates the signal transmission from electrostimulation site to the salivary center, as part of the salivary reflex. The red arrows denote the salivary reflex-mediated stimulation command running through the efferent fibers of the relevant nerves (trigeminal, facial and glossopharyngeal) from the salivary center to the salivary glands (submandibular, sublingual, parotid, minor).*

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EXTRAORAL DEVICES

Devices for transcutaneous electric nerve stimulation (TENS) are commonly used to treat musculoskeletal problems, in particular pain. A variety of such commercially available devices has been utilized as experimental tools for stimulating salivary function.

The TENS electrode pads are placed externally on the skin overlying the parotid glands, and the TENS unit is then activated (Fig. 2). The current intensity is felt and controlled by the patient, who can modulate it in order not to cause pain. Therefore, no real sham (placebo) can be used in clinical trials, because patients are be able to differentiate between an active and a sham device.

Studies have shown that TENS units are effective in increasing parotid gland salivary flow in healthy subjects and xerostomia patients, such as patients that received radiotherapy or allogeneic hematopoietic stem cell transplantation.[1,3,4,5] However, general weaknesses of the studies are lack of placebo (sham) control and of subjective parameter measurements.

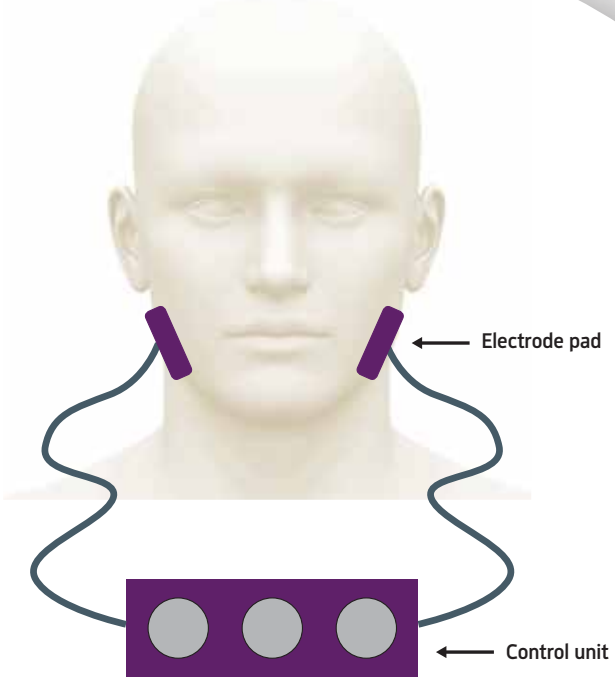

Fig. 2: *Illustrative presentation of the use of a transcutaneous electric nerve stimulation (TENS) apparatus to stimulate the parotid glands by placing a pair of pads containing electrodes on both preauricular areas. Electric cords connect the pads to the control unit used by the patient to modulate the current intensity.*

INTRAORAL DEVICES

Recently, a device called Saliwell was launched to the American market. It is a kind of mouth guard that carries an electronic circuit with a microprocessor, a pair of stimulating electrodes and two batteries, all linked together with electric wires (Fig. 3).

The electrodes of the device are in contact with the surface of the oral mucosa, which in turn lies at a distance of 1–5 millimeters from the lingual nerve (Fig. 4). The device is used for a period of five minutes, five times a day (Fig. 5). Stimulation current is weak and not felt by the patients. Thus, sham controlled trials can be easily performed, because patients don't feel any current by either the active or the sham device.

Fig. 5: *A patient wearing a Saliwell device.*

The device may be custom-made as shown, or universal (named "SaliPen") as depicted in Fig. 6. Both intraoral devices are FDA-cleared. Both devices share similar electronic parameters, but SaliPen has electrodes on both sides.

The intraoral device was tested in a double-blind trial comparing its effect on patients with xerostomia with the effect of the same appliance switched off (sham). It was demonstrated that the use of the device for 10 minutes increases oral moisture, according to measurements carried out by a humidity sensor placed on the apparatus.[6] In another double-blind, multinational trial with a sample of 114 patients with xerostomia, the effect of the device was evaluated over two months. The active device was superior to the sham device in terms of improvement in the severity and frequency of xerostomia and difficulties in swallowing.[7]

This study was extended to an uncontrolled phase, in which the positive effects were maintained during 11 months of use of the device. Moreover, at the end of the trial other subjective parameters such as oral discomfort, speech difficulty, frequency of waking at night and the rate of salivary flow (both unstimulated and stimulated by mastication) had improved.[8] Patients starting the trial with no collectable saliva developed during the study the ability to spit saliva. No significant adverse effects were observed.

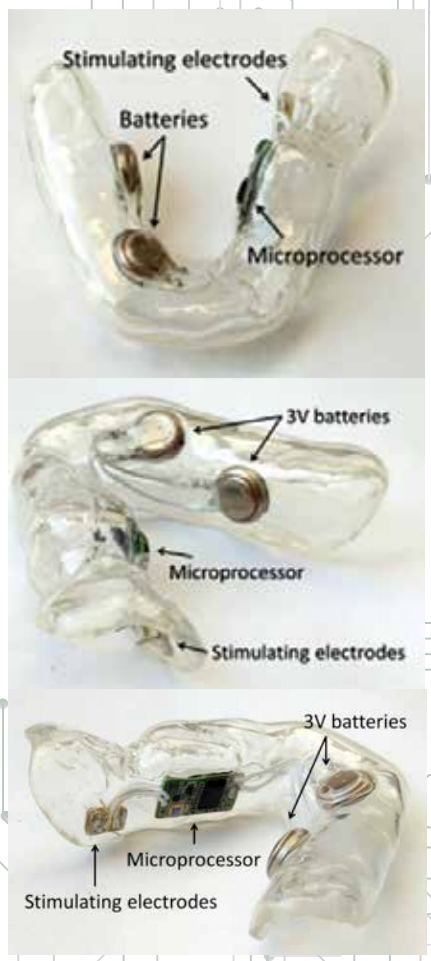

Fig. 3: *The Saliwell device seen from above (Fig. 3a) and from both sides.*

Fig. 4: *View from the lingual side of the area of electrostimulation.*

Fig. 6: *A SaliPen device placed on a model. A white extraoral control unit is linked to a blue intraoral stimulation unit, composed of two silicon-made flexible arms, each with a pair of electrodes designed to contact the oral mucosa, lingually to the third molar location.*

CONCLUSIONS

The most important outcome of xerostomia treatment efficacy is the degree of symptomatic improvement achieved, regardless of patient characteristics (e.g., underlying diagnosis, severity of hyposalivation).[9] There are very few patient-centered features that can guide the physician in choosing the specific treatment method to use. One of them is the general health status of the patient. In some circumstances, the use of systemic sialagogues such as pilocarpine or cevimeline may be contraindicated. In other cases, the use of these medications induces intolerable side effects. In these cases, other management methods are particularly relevant, such as electrostimulation.

In theory, agents that stimulate the salivary glands can be only beneficial for patients with residual salivary gland function. According to this axiom, individuals who are completely devoid of salivary output (i.e., have no residual active salivary gland tissue) can find relief only by using salivary substitutes. However, it is practically impossible to assert that the entire salivary glands have been destroyed by radiotherapy or by cellular infiltration in patients suffering from Sjögren's syndrome. Consequently, the use of electrostimulation may be beneficial in these cases, because only a small increase in secretion can alleviate the sensation of oral dryness.[10]

Intraoral electrostimulation of the lingual nerve produces an overall incentive of the nerves controlling salivary function by both afferent and efferent fiber stimulation. This type of nerve activation can potentially provoke regeneration of damaged salivary gland tissue, like in postradiation and Sjögren's syndrome patients. In fact, clinical studies have shown that in patients without any salivary output lingual nerve stimulation led to regaining their ability to spit saliva.[8,11] ■

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