The importance of saliva to oral and overall health is often overlooked by those outside the dental profession. Saliva is important for protection of hard and soft tissues, enamel mineralization and remineralization and digestion. Xerostomia is the subjective feeling of dry mouth and hyposalivation is the objective measure of salivary flow. Aging is not responsible for reduced salivary flow, but the medications taken by the elderly do cause xerostomia.

The following four steps help clinicians detect early signs of salivary gland hypofunction. First, ask questions about dry mouth with a visual analog scale for scoring: Do you have too much or too little saliva in your mouth? Do you have difficulty swallowing? Does your mouth feel dry while eating? Do you sip liquids to help swallow dry foods?

Second, review medical history and body systems. Sjogren's syndrome, rheumatoid arthritis, scleroderma, hypothyroidism, depression and eating disorders all impact salivary flow. Tobacco, alcohol and drug use will all affect salivary flow.

Third, complete a thorough clinical evaluation. How does the patient appear to you? Examine and palpate the salivary ducts. Are they enlarged or tender? Can you elicit saliva with palpation? Does the saliva pool? Visually check oral tissues for dryness. Use a tongue blade against the buccal mucosa to test for dryness. Check hard tissues for caries. Look at the lips for signs of dry, chapped or fissured appearance. Is the tongue dry, erythematous, lobulated or fissured?

Fourth, based on findings of the first three steps, further diagnostic tests may be needed. These tests range from measuring salivary flow to surgical biopsy of a salivary gland.

Clinical Implications: Several clinical steps provide valuable information in detecting salivary gland hypofunction.


Measuring Saliva in Clinical Practice

Biomarkers in saliva provide diagnostic information on oral, ovarian and breast cancer; HIV infection; Sjogren's Syndrome; and dental caries and periodontal disease. Saliva is also used to measure alcohol and illegal drug use and nicotine and cotinine levels associated with tobacco use. Physiologic changes associated with pregnancy and depression can also be detected in saliva.

Saliva collection can be from one or a mixture of glands and stimulated or unstimulated. Major salivary glands provide 90 percent of saliva, with minor glands providing the remaining 10 percent. Whole saliva is contaminated with food, micro-organisms and gingival crevicular fluid and consists of 99 percent water and one percent proteins and salts. Total daily output is between 0.5 liters and 1.5 liters. Minor salivary glands provide lubrication and protection for mucosal tissues. Unstimulated saliva is primarily from the submandibular glands and is both serous and mucous in nature. Stimulated saliva is from the parotid gland primarily and is completely serous in nature. The sublingual gland contribution to either stimulated or unstimulated saliva is minimal.

Reduced salivary flow negatively impacts the quality of life by causing difficulty with speaking, eating, swallowing and tasting. Objective measures are needed to accurately determine xerostomia. Salivary flow is simulated with gum base, paraffin wax, rubber bands and citric acid, and is collected by the patient spitting all saliva into a collection cup. Unstimulated salivary flow is collected from the mouth by having the patient tip his or her head forward and with an open mouth, allowing all saliva to run out of the mouth and into the collection container.

Clinical Implications: Dental practices have a variety of clinical means to measure salivary flow.

Salivary Flow Rates in the Elderly

Dry mouth is reported by elderly patients, but is not necessarily related to hyposalivation. Subjective feelings of dryness are reported in some who have normal salivary flow rates.

Researchers at the University of Helsinki in Helsinki, Finland, evaluated a group of 368 elderly people. This was a subgroup of a larger medical study of the elderly. Both stimulated and unstimulated salivary samples were collected from the group, however, some of the subjects showed signs of motor and cognitive impairment so samples were collected from 60 subjects for each of the saliva tests. They were also interviewed and asked 14 questions about oral dryness and dryness of the throat, eyes, nose and skin.

Of this group, 46 percent complained of some oral dryness. Continuous dry mouth was reported by 12 percent of the group. Others reported dry mouth in the morning (36 percent), during the day (19 percent) and in the evening (16 percent). Common complaints were dryness while speaking, taste impairment, difficulty swallowing dry foods and dry lips. Extra-oral dryness was reported for dry eyes and dry skin. More women than men reported dry mouth symptoms.

Waking up at night to drink was reported by 34 percent. It was not just water that they drank, but also juice, soft drinks, milk and beer. This may be a significant factor in caries risk among the elderly. Those taking medications also reported more oral dryness. Mouth breathing causes evaporation of saliva, leading to dry mouth and increasing risk of caries.

Clinical Implications: Look for dry mouth more frequently in women, those who mouth breathe and those who take medications.


Clinical Signs that Predict Low Salivary Flow Rates

Salivary gland hypofunction leads to several problems including caries, periodontitis, mucositis, angular cheilitis and altered taste. “Dry mouth” was first described in the literature in 1868 and xerostomia in 1889. It wasn’t until 1967 that standardized methods for measuring salivary flow rates were introduced in a study of 50 patients with xerostomia. In 1987 it was reported that questions about dry mouth helped identify those who needed further salivary tests.

Researchers at the University of Pennsylvania School of Dental Medicine designed a study to compare subjects with and without normal salivary flow. The group consisted of 23 men and 48 women ranging in age from 19 to 82 years, the average being 52 years. Subjects underwent the tests three times at different times during the day, to take into account the influence of circadian rhythm. A total of 64 measures were taken on each patient, each time. Measurements were taken for lip dryness, buccal mucosa dryness, salivary gland palpitation, tongue, periodontal tissues and total DMFT. Saliva collection included stimulated and unstimulated whole saliva. Additionally, saliva samples were collected from right and left parotid glands.

A diagnosis of salivary gland hypofunction relies on salivary flow rate measures. This study demonstrated that other measures could reliably predict those who will have salivary hypofunction, but not the cause of the hypofunction. Together lip dryness, buccal mucosa dryness, salivary gland palpation for flow and DMFT scores successfully identified those with low salivary flow test scores.

Clinical Implications: Together, checking dryness of the lips and buccal mucosa, total DMFT and absence of saliva with gland palpitation are accurate signs of salivary gland dysfunction.


continued on page 122
Salivary Clearance of Sugar from the Mouth

Salivary clearance of sugar from the mouth is important for reducing risk of dental caries. Previous researchers studied the changes in the total volume of saliva secreted in response to 2mL of acid held in the mouth for one minute. What they were unable to determine was if the salivary flow rate changed during the exposure to the acid.

Researchers at the University of Manitoba in Winnipeg, Canada devised a method to measure flow rate changes in saliva when the subject was exposed to sugar, sodium chloride or citric acid. Twelve young adults, six men and six women participated in this study. Saliva flowed from the subject’s mouth into a funnel beaker that sat on a balance that measured each 0.01mL increase in the salivary flow rate.

The three test tastes were introduced in a fluid state and removed immediately over an exposure time of three minutes, followed by a washout period using only water until salivary flow rate stabilized. A rest period of five minutes was allowed between tests. A high and a low concentration were tested for each taste, providing six tests per subject.

The delay between the taste stimulation and maximum salivary flow rate was 9.4 seconds. From this point, the flow rate half-life was determined to be 11 seconds even though the taste stimulation continued for three minutes. There were no statistically significant differences in salivary flow rates between the three tastes tested. Regarding sugar, taste adaptation reduces salivary flow rates, thus slowing clearance of the sugar.

Clinical Implications: These findings show full salivary clearance of sugar takes 25 to 45 minutes.

Clinical Implications: Stimulating salivary flow after eating can reduce the incidence of dental caries.

The Importance of Saliva in Preventing Caries

Enamel will demineralize at a pH of 5.5, dentin at a pH of six. Plaque pH drops below 5.5 within three minutes of exposure to sucrose, flour or other fermentable carbohydrates. Saliva is responsible for returning the plaque pH to a level that does not lead to enamel demineralization. Reduced salivary flow results in a great drop in plaque pH and a longer recovery time. Besides neutralizing the acids produced in plaque biofilm, saliva has the ability to remineralize enamel or dentin that has been demineralized. In 1966 Dr. Backer Dirks reported on 70 seven-year-old children with a total of 72 white spots lesions that were monitored over eight years. Of these lesions, nine progressed to cavitation, 26 were arrested and unchanged and 37, more than half, were remineralized and no longer detectable clinically.

The increased prominence of sugar- and flour-containing foods is a risk for dental caries, but food alone is not responsible. Stimulated saliva is instrumental in elevating the pH of plaque. Saliva contains bicarbonate and the concentration increases with prolonged stimulation of salivary flow, favoring elevation of the pH and remineralization of enamel rather than demineralization.

Several studies demonstrate the value of chewing sugarless gum after meals to stimulate salivary flow and elevate plaque pH. Sorbitol-sweetened chewing gums are not always better than no-gum groups but have been reported to reduce caries from zero to 20 percent while xylitol-sweetened gums reduce caries 43 to 71 percent, depending on dose and daily frequency, three versus five exposures each day. Stimulation of salivary flow from gum chewing plus xylitol reduces caries rates significantly.

Clinical Implications: Stimulating salivary flow after eating can reduce the incidence of dental caries.