Saliva and Oral Health

The anatomy and physiology of salivary glands

Patients suffering from dry mouth can experience difficulty with eating, swallowing, speech, the wearing of dentures, trauma to and ulceration of the oral mucosa, taste alteration, poor oral hygiene, a burning sensation of the mucosa, oral infections including Candida and rapidly progressing dental caries. The sensation of dry mouth or xerostomia is becoming increasingly common in developed countries where adults are living longer. In addition, polypharmacy is very common among the older adult population and many commonly prescribed drugs cause a reduction in salivary flow. Xerostomia also occurs in Sjögren’s syndrome, which is not an uncommon condition.

In addition to specific diseases of the salivary glands, salivary flow is usually severely impaired following radiotherapy in the head and neck area for cancer treatment in both children and adults of all ages. Clearly oral dryness is a problem which faces an increasingly large proportion of the population. An understanding of saliva and its role in oral health will help to promote awareness among health care workers of the problems arising when the quantity or quality of saliva is decreased; this awareness and understanding is important to the prevention, early diagnosis and treatment of the condition.

There is an extensive body of research on saliva as a diagnostic fluid. It has been used to indicate an individual’s carrier susceptibility; it has also been used to reflect systemic physiological and pathological changes which are mirrored in saliva. One of the major benefits of saliva is that it is easily available for non-invasive collection and analysis. It can be used to monitor the presence and levels of hormones, drugs, antibodies, microorganisms and ions.

The following information provides an overview of the functions of saliva, the anatomy and histology of salivary glands, the physiology of saliva formation, the constituents of saliva and the use of saliva as a diagnostic fluid, including its role in cancer risk assessment.

Functions of Saliva

The complexity of this oral fluid is perhaps best appreciated by the consideration of its many and varied functions. The functions of saliva are largely protective; however, it also has other functions, including:

Fluid/Lubricant – Coats hard and soft tissue which helps to protect against mechanical, thermal and chemical irritation and tooth wear. Assists smooth air flow, speech and swallowing.

Ion Reservoir – Solution saturated with respect to tooth mineral facilitates remineralisation of the teeth.

Buffer – Helps to neutralise plaque pH after eating, thus reducing time for demineralisation.

Cleansing – Clears food and aids swallowing.

Antimicrobial actions – Specific (e.g. slgA) and non-specific (e.g. Lysozyme, Lactoferrin and Myeloperoxidase) antimicrobial mechanisms help to control the oral microflora.

Agglutination – Agglutinins in saliva aggregate bacteria, resulting in accelerated clearance of bacterial cells. Examples are mucins and parotid saliva glycoproteins.

Pellicle formation – Thin (0.5 μm) protective diffusion barrier formed on enamel from salivary and other proteins.

Digestion – The enzyme amylase is the most abundant salivary enzyme; it splits starch foods into maltose, maltotriose and dextrins.

Taste – Saliva acts as a solvent, thus allowing interaction of foodstuffs with taste buds to facilitate taste.

Water balance – Under conditions of dehydration, salivary flow is reduced, dryness of the mouth and information from ororeceptors are translated into decreased urine production and increased drinking.

Changes in plaque pH following sucrose ingestion and buffering capacity in the presence of saliva.
Following a sucrose rinse the plaque pH is reduced from approximately 6.7 to less than 5.0 within a few minutes. Demineralisation of the enamel takes place below the critical pH of approximately 5.5. Plaque pH stays below the critical pH for approximately 15-20 minutes and does not return to normal until about 40 minutes after the ingestion of the sucrose rinse. Once plaque pH recovers to a level above the critical pH, the enamel may be remineralised in the presence of saliva and oral fluids which are supersaturated with respect to hydroxyapatite and fluorapatite.

Anatomy and histology

The type of salivary secretion varies according to gland. Secretions from the parotid gland are watery in consistency, those from the submandibular and sublingual glands, and particularly the minor mucous glands, are much more viscous, due to their glycoprotein content. The histology of the gland therefore varies according to gland type.

All of the salivary glands develop in a similar way. An ingrowth of epithelium from the stomatodaeum extends deeply into the ectomesenchyme and branches profusely to form all the working parts of the gland. The surrounding ectomesenchyme then differentiates to form the connective tissue component of the gland i.e. the capsule and fibrous septa that divide the major glands into lobes. These developments take place between 4 and 12 weeks of embryonic life, the parotids being the first and the sublingual and the minor salivary glands being the last to develop. The minor salivary glands are not surrounded by a capsule but are embedded within the connective tissue.

Formation of saliva

The fluid formation in salivary glands occurs in the end pieces (acini) where serous cells produce a watery seromucous secretion and mucous cells produce a viscous mucin-rich secretion. These secretions arise by the formation of interstitial fluid from blood in capillaries, which is then modified by the end piece cells. This modified interstitial fluid is secreted into the lumen. From the lumen it passes through the ductal system where it is further modified. Most of the modification occurs in the striated ducts where ion exchange takes place and the secretion is changed from an isotonic solution to a hypotonic one. The composition of saliva is further modified in the excretory ducts before it is finally secreted into the mouth.

Physiology of saliva formation

Composition and flow rate

The composition of saliva varies according to many factors including the gland type from which it is secreted. Salivary flow rate exhibits circadian variation and peaks in the late afternoon. Normal salivary flow rates are in the region of 0.5-0.6 l/min when unstimulated and 1.5-2.0 l/min when stimulated. Approximately 0.5 – 0.6 litres of saliva is secreted per day. Many drugs used for the treatment of common conditions such as hypertension, depression and allergies (to mention but a few), also influence salivary flow rate and composition.

Saliva as a diagnostic fluid

Caries risk assessment

A number of caries risk assessment tests based on measurements in saliva have been developed, for example tests which measure salivary mutants streptococci and lactobacilli and salivary buffering capacity. High levels of mutants streptococci, i.e. >105 colony forming units (CFUs) per ml of saliva, are associated with an increased risk of developing caries. High levels of Lactobacilli (>105 CFUs per ml saliva) are found amongst individuals with frequent carbohydrate consumption and are also associated with an increased risk of caries.

Buffering capacity – Higher buffering capacity indicates better ability to neutralise acid and therefore more resistance to demineralisation.

In addition to showing promise for the prediction of periodontal disease progression and caries levels, analysis of saliva has been employed in pharmacogenomics, as well as the evaluation and assessment of endocrine studies. Saliva not only plays a pivotal role in the maintenance of a healthy homeostatic condition in the oral cavity, but contributes to one’s overall health and wellbeing. Components from saliva interact in different ways with the dentition to protect the teeth. Patients who lack sufficient saliva suffer from many oral diseases, of which caries is only one. To alleviate discomfort they are advised to use saliva stimulants and substitutes which have the function of lubricating the oral surfaces. Chewing gum is increasingly being viewed as a delivery system for active agents that could potentially provide direct oral care benefits, as it promotes a strong flow of stimulated saliva.

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"Pediatric dental community has evolved"