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REVIEW

Novel impacts of saliva with regard to oral health

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ABSTRACT

The maintenance of balanced oral homeostasis depends on saliva. A readily available and molecularly rich source of biological fluid, saliva fulfills many functions in the oral cavity, including lubrication, pH buffering, and tooth mineralization. Saliva composition and flow can be modulated by different factors, including circadian rhythm, diet, age, drugs, and disease. Recent events have revealed that saliva plays a central role in the dissemination and detection of the SARS-CoV-2 coronavirus. A working knowledge of saliva function and physiology is essential for dental health professionals. (J Prosthet Dent 2022;127:383-91)

Saliva is essential for the maintenance of oral health.[1] Human salivary glands produce from 0.5 to 1.5 liters of total saliva in a 24-hour period. A complex fluid, containing electrolytes, salivary and serum proteins, and small organic molecules, as well as metabolites and debris from microorganisms that colonize the mouth, saliva functions to moisten and protect oral tissues, clean the gingiva and teeth, and aids speaking and swallowing. Additional essential roles include buffering of the oral cavity, protective pellicle formation, tooth mineralization, antimicrobial activity, tissue repair, and taste and digestion. Radiation therapy for head and neck cancers, autoimmune diseases such as Sjögren's syndrome, as well as other systemic diseases and many medications can decrease saliva production; this condition is known as xerostomia and has multiple often debilitating consequences. Given the central role of saliva in oral health and disease, an up-to-date understanding of its physiology and functions is essential for dentists and health professionals.

HUMAN SALIVARY GLANDS: STRUCTURE AND COMPOSITION

Three pairs of major salivary glands collectively produce approximately 90% of total saliva. The remainder is produced by hundreds of minor salivary glands located in submucosal tissues lining the oral cavity.[2] The major salivary glands consist of clustered secretory cells known as acini, which produce the primary saliva and secrete most salivary proteins.[3] Serous acinar cells secrete a watery saliva containing proteins such as alpha-amylase, while mucous acinar cells secrete a stickier saliva containing mucins, highly glycosylated proteins that function to increase viscosity. Acini secrete saliva into small intercalated ducts linked to a ductal tree of larger striated ducts which coalesce and ultimately terminate in the excretory ducts that empty into the oral cavity. As the isotonic fluid secreted by the acini passes through this system, duct cells actively modify the ionic composition through resorption.[3] The ducts are lined by the epithelial cells of heterogeneous cell types,[4,5] some of which also secrete salivary proteins.[6]

The parotid glands (PGs), the largest of the major salivary glands, are made up of serous acini.[7] PG excretory ducts, known as Stensen ducts, open on both surfaces of the buccal mucosa near the second maxillary molar (Fig. 1).[8] The submandibular glands (SMGs), located inferiorly to the mandible, include both serous and mucous acini, which secrete saliva of moderate viscosity[7] into the oral cavity by way of the Wharton excretory ducts, located at the sublingual caruncle below the tongue. Together, the PGs and SMGs produce the major volume of saliva. The smallest sublingual glands (SLGs) are located between the muscles of the lower oral

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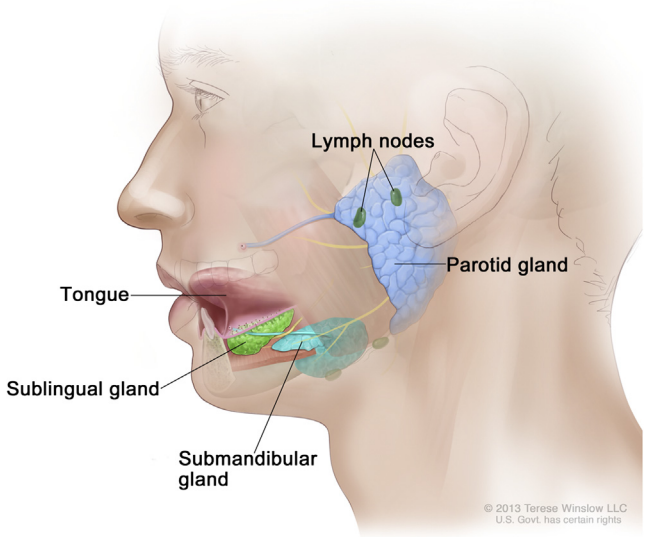

Figure 1. Location of parotid, submandibular, and sublingual major salivary glands in relation to tongue, mandible, and oral cavity. Points of entry of excretory ducts from each gland into oral cavity indicated. Nerves shown in *yellow*. Reprinted with permission. © 2013 Terese Winslow LLC, U.S. Govt. has certain rights.

cavity floor. The SLGs secrete a small volume of highly viscous saliva produced by mucous acini, mixed with a few serous acinar cells, which passes through the Bartholin and Rivinus ducts into the oral cavity at the sublingual caruncle and the sublingual fold, respectively. Hundreds of minor salivary glands, approximately 1 to 2 mm in size, drain into short excretory ducts which are widely distributed throughout the oral submucosa.[9] With the exception of von Ebner glands, which are serous, the minor salivary glands are made up of mucous acini.

SALIVA SECRETION

The mechanism of saliva secretion is the same in all salivary glands, although the composition and volume of saliva produced vary widely.[10,11] Multiple ion and water channels, exchangers, and transporter proteins act in a coordinated manner to produce and secrete saliva.[12] The secretion process is controlled by parasympathetic nerves which release acetylcholine that binds to muscarinic receptors on the acinar cell membrane.[3,13] Stimulation of the receptors results in increased intracellular Ca^{2+}, which drives electrolytes into intercalated ducts, followed by water.[11] Salivary glands are also innervated by sympathetic nerves, which release noradrenaline that binds to adrenergic receptors and promotes secretion of salivary proteins. Minor salivary glands are innervated by parasympathetic nerve fibers.[14]

Under unstimulated conditions, the SMG make the highest contribution to whole saliva volume (SMG: 60%, PG: 25% to 30%, SLG: 8%). However, under stimulated conditions, the PG contribution is highest (SMG: 35%, PG: 50%, SLG: 8%).[1] Minor salivary glands secrete 10% of total resting saliva.[2] In healthy adults, the mean flow rate of unstimulated whole saliva is 0.3 to 0.4 mL/min, and a flow rate of less than 0.1 mL/min is classified as hyposalivation.[15] In contrast, the mean stimulated saliva flow rate is reported to range from 1.5 to 2.0 mL/min.[15] There are significant differences in the composition of stimulated and unstimulated saliva (Table 1).[16,17] The concentration of inorganic and organic components changes with stimulation, as does the hypotonicity. The bicarbonate concentration of stimulated saliva is also many times higher than that of unstimulated saliva. However, the total protein content is decreased in stimulated saliva.

The rate of saliva secretion can be modulated by different factors.[18] Secretion of both unstimulated and

Table 1. Concentration and composition of unstimulated and mastication-stimulated whole human saliva

Salivary Components	Concentration in Unstimulated Saliva	Concentration in Stimulated Saliva
H2O	99.55%	99.53%
Solids	0.45%	0.47%
—	Mean ±S.D.	Mean ±S.D.
Flow rate (mL/min)	0.32 ±0.23	2.08 ±0.84
pH	7.04 ±0.28	7.61 ±0.17
Inorganic constituents	—	—
Sodium (mmol/L)	5.76 ±3.43	20.67 ±11.74
Potassium (mmol/L)	19.47 ±2.18	13.62 ±2.70
Calcium (mmol/L)	1.32 ±0.24	1.47 ±0.35
Magnesium (mmol/L)	0.20 ±0.08	0.15 ±0.05
Chloride (mmol/L)	16.40 ±2.08	18.09 ±7.38
Bicarbonate (mmol/L)	5.47 ±2.46	16.03 ±5.06
Phosphate (mmol/L)	5.69 ±1.91	2.70 ±0.55
Thiocyanate (mmol/L)	0.70 ±0.42	0.34 ±0.20
Iodide (µmol/L)	NA	13.8 ±8.5
Fluoride (µmol/L)	1.37 ±0.76	1.16 ±0.64
Organic constituents	—	—
Total protein (mg/L)	1630 ±720	1350 ±290
Secretory IgA (mg/L)	76.1 ±40.2	37.8 ±22.5
MUC5B (mg/L)	830 ±480	460 ±200
MUC7 (mg/L)	440 ±520	320 ±330
Amylase (U=mg maltose/mL/min)	317 ±290	453 ±390
Lysozyme (mg/L)	28.9 ±12.6	23.2 ±10.7
Lactoferrin (mg/L)	8.4 ±10.3	5.5 ±4.7
Statherin (µmol/L)	4.93 ±0.61	NA
Albumin (mg/L)	51.2 ±49.0	60.9 ±53.0
Glucose (µmol/L)	79.4 ±33.3	32.4 ±27.1
Lactate (mmol/L)	0.20 ±0.24	0.22 ±0.17
Total lipids (mg/L)	12.1 ±6.3	13.6
Amino acids (µmol/L)	780	567
Urea (mmol/L)	3.57 ±1.26	2.65 ±0.92
Ammonia (mmol/L)	6.86	2.57 ±1.64

Data show concentrations of salivary components in unstimulated and in mastication-stimulated saliva. Concentrations shown as mean ±standard deviation. Reproduced with permission from *Saliva and Oral Health: An essential overview for the health professional*, fourth edition[16] and with grateful acknowledgment to C. Dawes. NA, not available.

stimulated saliva fluctuates in circadian rhythms, with peak flow in the late afternoon and the lowest flow rate during sleep.[19] Taste, smell, and mastication all stimulate salivary secretion. Moreover, environmental conditions such as lower temperatures influence saliva flow rates.[20,21]

Given the variability in saliva flow rate and composition, proper collection requires standardization of time of day, type of stimulation, environmental conditions, and type of collection device. In addition, the sampling method, sample storage conditions, duration of time before analysis, and methods of analysis must be controlled.[22-24]

SALIVA COMPOSITION: MORE THAN JUST WATER

Human saliva is approximately 99% water, but the remaining 1% includes electrolytes, enzymes, hormones, nucleic acids, cytokines, antibodies, and sugars, yielding a far more complex biofluid.[1] Many ions such as K^+, Ca^{2+}, HCO_3^-, Na^+, Cl^-, and PO_4^{3-} fulfill important roles in saliva function. Saliva contains carbohydrates, blood-group substances, lipids, and vitamins, as well as many proteins, including alpha-amylase, mucins, lysozyme, immunoglobulin A (IgA), lactoferrin, proline-rich proteins, histatins, peroxidase, defensins, glycoproteins, lipoproteins, statherin, and matrix metalloproteases.[1] However, the early estimates of nearly 3000 proteins present in whole saliva[25-30] have been revised, as a large number are derived from sources other than the salivary glands.[29,31] Importantly, microorganisms, desquamated epithelial cells, gingival crevicular fluid (GCF), serum, and food debris present in the oral cavity also contribute to the salivary proteome.[1]

Saliva composition varies between individuals and depends on a multitude of factors, including sex, age, health status, and time of day. Saliva pH, protein content, and lysozyme activity differ between men and women,[32] and saliva composition and flow rate can vary with age.[33] Salivary flow rates and saliva composition are altered by anticholinergic, sympathomimetic, and antihypertensive medications.[34] Salivary disorders associated with decreased saliva flow include Sjögren's syndrome, diabetes, depression, and Down syndrome.[1] Alterations in salivary components vary with diseases such as cancer or diabetes and conditions such as obesity.[35] Reports that the molecular profile of saliva reflects the physiological status of the individual[36] have been widely embraced to promote saliva as a diagnostic fluid.

SALIVA: A COMPLEX BIOLOGICAL FLUID WITH MULTIPLE FUNCTIONS

Saliva fulfills a broad array of functions, which have been comprehensively described elsewhere.[1,16,37] This review will focus on newly uncovered roles for saliva, particularly in wound healing, taste perception, and as a diagnostic fluid.[1,37]

INTERACTIONS BETWEEN SALIVA AND ORAL SURFACES

Saliva coats the oral soft tissues in what is known as the mucosal pellicle, a hydrogel-like layer made up of heavily glycosylated mucin proteins that trap and retain water to form a thick viscoelastic layer.[37,38] The mucosal pellicle maintains lubrication in the oral cavity, the pharynx, and the esophagus, creating a barrier that protects oral tissues from dryness and mechanical stress.[38] Notably, saliva from PG and from SMG and SLG has the same lubricating properties, but different viscosities, indicating that lubrication is not entirely dependent on mucins.[39] Artificial saliva substitutes produced for patients with xerostomia often fail to replicate the sustained lubricating qualities of the mucosal pellicle in the oral cavity.[40,41]

The metabolism of ingested carbohydrates in the oral cavity results in a drop in pH,[2] and below pH 5.5, tooth enamel erosion occurs.[42] Saliva plays a central role in maintaining the oral pH in a range of 6.8 to 7.8 through the buffering capacities of bicarbonate (HCO_3^-)[43] and phosphate.[44] Bicarbonate and phosphate are important in the cyclic processes of demineralization and remineralization, which act to protect against dental caries. Salivary proteins such as statherin bind calcium or phosphate to maintain the supersaturation of these electrolytes in the saliva and to prevent excess deposition of calcium phosphate on tooth surfaces.[45]

When exposed to saliva, a thin organic film known as the acquired enamel pellicle (AEP) rapidly forms on the surface of tooth enamel. The AEP consists predominantly of salivary proteins complexed with glycoproteins, carbohydrates, and lipids,[46,47] and oral bacteria contribute as well.[48] The AEP forms a diffusion barrier that reduces calcium release from tooth enamel and protects against abrasion, erosion, demineralization, and dental caries.[49] As an attachment site for initial colonizers of the dental biofilm, the AEP influences the composition of the oral microbiome.[46]

SALIVA AND ORAL INFECTION

The oral cavity is a major entry portal for pathogens and can be colonized by more than 700 different microbial species.[50] Dozens of antimicrobial proteins and peptides involved in both innate and acquired immunity[51] are secreted by the salivary glands, oral epithelial cells, and resident immune cells.[52] The low frequency of infections arising after injuries in the oral cavity highlights the effectiveness of host defense mechanisms. However, as the antimicrobial proteins are present at minimal

inhibitory concentrations, they do not completely eliminate the oral microbiome.[37,52]

The protective activity of these proteins varies. Defensins are cationic proteins which bind to bacteria; lysozyme hydrolyzes bacterial cell walls, resulting in lysis; cathelicidin binds bacterial toxins such as LPS; cystatins inactivate bacterial proteases; and lactoferrin, a Fe^{3+} chelator, inhibits microbial metabolic activity.[52] The terminal sialic acids of mucins promote bacterial aggregation and the clearance of bacteria from the oral cavity[53] and are implicated in the inhibition of HIV in the oral cavity.[54] Histatins, salivary peptides produced only in humans and higher primates, are fungicidal[55] and show potent antibacterial activity against common multidrug-resistant bacterial species.[56] Human salivary glands also secrete immunoglobulins.[7,29] IgA knockout mice showed an increased level of alveolar bone loss compared with wild-type control mice, which may suggest that salivary IgA plays a role in preventing periodontal disease.[57] Some antimicrobial proteins are differentially regulated in the presence of periodontal disease, supporting their use as diagnostic biomarkers.[52,58]

In contrast with skin, soft tissues in the oral cavity heal rapidly with no scarring.[59] Cells in the buccal mucosa turnover 2 times faster than those in skin epithelium.[60] Saliva continuously lubricates the wound, reducing tissue dehydration and cell death, and provides various cytokines, chemokines, and growth factors to promote wound healing.[61,62] Histatins are potent activators of wound healing[63,64] and show therapeutic potential for promoting tissue repair.

SALIVA AND FOOD

Humans can detect 5 basic tastes: sour, salt, sweet, bitter, and umami,[65] and recent work suggests that a sixth type of taste receptor detects free fatty acids.[66] It is the interaction of saliva with food during bolus formation that informs the perception of taste. Saliva plays a central role by dissolving and diffusing food substances within the oral cavity.[67] In humans, significant variations in flavor perception are related to differences in salivary protein composition.[68] Hormones present in saliva, such as leptin, ghrelin, insulin, and glucagon, have been shown in animal models to modulate taste perception.[67] Repeated exposure of mice to bitter compounds upregulates specific salivary proteins that alter taste, reducing sensitivity to such compounds.[69] In humans, proline-rich proteins bind food substances such as tannins to modulate astringency.[70] Numerous enzymes in saliva contribute to taste perception through the proteolysis of dietary proteins, and alterations in enzyme expression levels may underlie certain taste disorders. Taste receptors can be damaged by dryness or microbial infections, which affects taste perception in patients with hyposalivation.[67]

Saliva functions in the clearance of food debris from the oral cavity. The most abundant salivary protein, alpha-amylase, plays only a limited role in starch digestion[71] and is likely more important in the dissolution and removal of food particles from the teeth.[72] The use of sugar-free gum, which is positively linked to reduced dental caries,[73] depends on mastication to stimulate saliva secretion.[74] The increased incidence of dental caries in patients with salivary hypofunction is directly linked to reduced salivary clearance rates.[37]

SALIVA AS A DIAGNOSTIC TOOL

As a diagnostic fluid, saliva offers clear advantages over blood. Saliva collection is straightforward, noninvasive, and generally painless; does not require trained personnel or sterile equipment; and can be done by the participants themselves. Saliva presents significantly lower risks of inadvertent pathogenic infection than blood collection[22] and is a noninvasive alternative for infants[75] or individuals with mental illness.[76] Saliva collection is widely used for drug and medical testing and for the analysis of genetic molecules and proteins.[77] Desquamated epithelial cells and blood cells in the oral cavity are a ready source of human deoxyribonucleic acid (DNA), and microbial flora provide a unique set of bacterial species per individual, making saliva critical in forensic investigations.[78,79]

Major technical advances in salivary proteomics have enabled comparative profiling analyses and the identification of potential biomarkers. Salivary proteins are currently under investigation as diagnostic biomarkers for a wide variety of oral,[80] as well as systemic, diseases.[81] The current challenge is to unambiguously link disease biomarkers with specific physiological conditions.[23]

SALIVA AS A PREDICTOR OF ORAL DISEASE

The potential for exploiting specific salivary protein components as biomarkers in the diagnosis of oral diseases has long been recognized.[82] Of particular interest is whether salivary biomarkers may be predictive of dental caries. To date, only weak evidence has linked caries with specific salivary components [83] or shown that saliva pH, buffering capacity, proteins, or electrolyte composition serve as effective indicators of the risk factors causing dental caries.

Periodontitis develops as a result of change in the host environment.[84] Whether there is a link between saliva flow rates and periodontitis has been the subject of conflicting reports.[85] Saliva functions in periodontitis both to promote bacterial adherence and AEP formation and to protect, through the activities of antimicrobial proteins, secreted antibodies and rapid clearance. Responses to periodontitis include increased inflammatory cytokines.[86,87] In particular, interleukin-1β (IL-1β) and matrix metalloproteinase-8 (MMP-8) are significantly

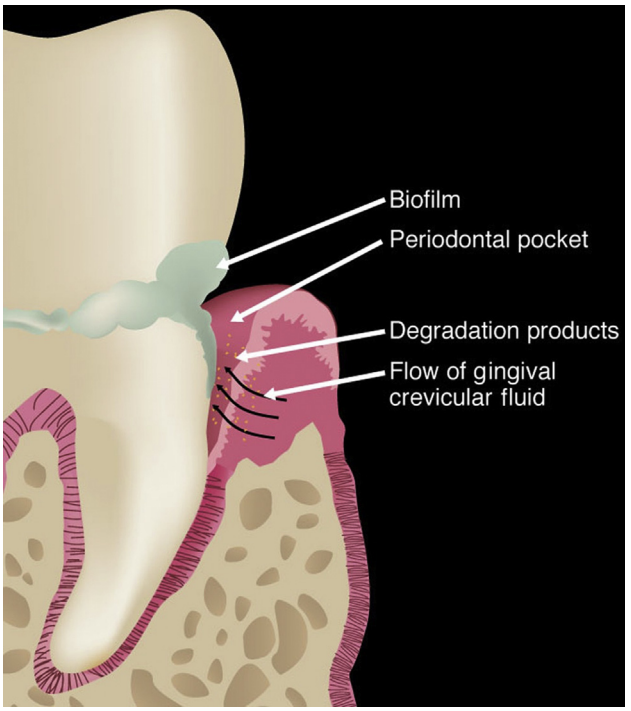

Figure 2. Illustration of how gingival crevicular fluid (GCF) passes through epithelial cells in periodontal tissues before entering periodontal pocket (*black arrows*). For patients with periodontal disease, GCF passing through inflamed tissues may accumulate higher concentrations of disease-specific biomarkers than present in whole saliva. Reprinted with permission from Barros et al. Periodontology 2000 (2015),[92] ©John Wiley &Sons A/S. Published by John Wiley & Sons Ltd.

elevated in the whole saliva of patients with periodontitis and have been suggested as promising salivary biomarkers.[88-91] However, because GCF passes through inflamed periodontal tissues before entering the sulcus, the current focus of most saliva-based tests for periodontal disease is the detection of biomarkers present at higher concentrations in the GCF (Fig. 2).[92,93] A recently revised classification system to define the clinical stages of periodontitis[94] is compatible with the inclusion of specific salivary biomarkers to distinguish progressive stages of the disease by severity.

Saliva metabolome analysis has been used to detect metabolites associated with tissue breakdown, beta-oxidation, proinflammatory mediator production, pH regulation, reactive oxygen species generation, and subsequent antioxidative defense.[95-97] However, while many promising disease-specific metabolites have been detected, an incomplete understanding of specific metabolic pathways associated with oral diseases remains a limitation. Human immunodeficiency virus (HIV) infection and antiretroviral therapies are associated with oral diseases, including periodontitis, necrotizing ulcerative gingivitis, oral candidiasis, hairy leukoplakia, and aphthous ulcers.[98,99] More than 100 salivary biomarkers have been proposed for oral cancers.[100,101] However, a majority of these, including interleukin 6 (IL-6), interleukin 10 (IL-10), tumor necrosis factor alpha (TNF-alpha), and interferon gamma (IFN-gamma), are inflammatory markers that are elevated in patients with various diseases, making them relatively nonspecific markers for cancer.[102,103] The validation of biomarkers must first rule out compounding factors such as periodontitis, Sjögren's syndrome, or stress, which also increase cytokine levels.

SALIVA AS A PREDICTOR OF SYSTEMIC DISEASES

The analysis of human saliva has been applied to the diagnosis of many systemic diseases. Extensive efforts are underway to validate novel salivary biomarkers for Sjögren's syndrome,[104] neurological diseases,[105,106] early diagnosis of Alzheimer disease,[107] diabetes,[108] cardiovascular disease, and autoimmune disorders. A strong correlation between levels of salivary and blood glucose suggests that saliva can be used for monitoring blood glucose concentration.[109,110] The link between periodontitis and type I diabetes suggests that further characterization of salivary biomarkers for both conditions may prove useful for screening the progression and control of diabetes.[105,111]

The quantity and enzymatic activity of salivary amylase vary widely among individuals. A recent study noted a positive correlation between the amylase gene copy number and high-starch or low-starch diets in various human populations,[112] suggesting that expression levels of amylase may be linked to obesity, but extensive genomic analysis revealed no association between the 2.[113]

Childhood obesity is associated with a reduction in salivary gland flow,[114] which has been attributed to an increase in proinflammatory cytokines secreted by adipocytes and macrophages that impair salivary gland function.[115] Salivary redox biomarkers (uric acid, sulfhydryl groups) are altered in obese individuals,[116] although studies relating salivary biomarkers of oxidative stress to obesity-related conditions such a hyperlipidemia, insulin resistance, or type 2 diabetes are so far inconclusive.[117] Insulin, adiponectin, or resistin in saliva has been correlated with serum levels in patients with diabetes.[118] Levels of antioxidants are similarly elevated in saliva and serum of patients with diabetes and chronic kidney disease.[119]

Because of the ease of collection, saliva analysis is a practical approach to evaluating mental stress in adults, most often by assaying for cortisol.[120,121] Salivary cortisol is used as a biomarker for psychiatric disorders, including anxiety and depression, and for patients with high risk of schizophrenia.[122] Salivary cortisol is also used to monitor stress in neonates under intensive care.[123]

Secretory protein release from the salivary glands is stimulated by sympathetic neural activity. For this reason,

salivary alpha-amylase (sAA) has been proposed as a diagnostic marker for systemic stress.[124] In the past 10 years, dozens of studies have been conducted to measure cortisol and sAA as markers of cardiovascular stress,[125] although the reliability of sAA as a marker of stress has been challenged. sAA levels are linked to saliva flow rate, which is modulated both by sympathetic and parasympathetic signals.[126] Notably, cortisol levels are under circadian control,[127] and both markers can be influenced by various confounders, including age, sex, medication, health conditions, smoking, drinking, and sleep habits.

Saliva is a critical diagnostic fluid for the detection of viruses, including congenital cytomegalovirus,[128] Epstein-Barr, hepatitis B,[129] HIV,[130-132] and human papilloma virus.[133] Saliva is the focus of diagnostic tests for dengue,[134] herpes simplex, and Zika viruses.[135]

SALIVA AND THE COVID-19 PANDEMIC

The recent COVID-19 pandemic clearly illustrates how central saliva can be in disease. The primary source of SARS-CoV-2 transmission is saliva, which is disseminated through aerosols produced by sneezing, coughing, speaking, singing, or contact with the mucous membranes of affected individuals.[136,137] SARS-CoV-2 is present at high viral load in saliva and can be used for the rapid detection of virus ribonucleic acid (RNA) and antigens, as well as for antibodies produced against it.[138,139] Saliva samples have proven as effective as mucosal samples collected from nasopharyngeal swabs in detecting SARS-CoV-2, and the ease of collection reduces the inadvertent exposure of health-care workers.[140,141] Development of rapid test kits has simplified saliva-based testing for RNA or viral antigens.[138-140,142-147] In addition, a highly sensitive test based on CRISPR-Cas13-RNA detection has recently been developed, which dramatically shortens the time to results.[148]

SARS-CoV-2 can be transmitted by asymptomatic, presymptomatic, and symptomatic individuals.[141] Importantly, it has been demonstrated that saliva from asymptomatic individuals can be highly infectious.[149] Furthermore, the virus may persist in saliva, after it is no longer detectable in nasopharyngeal swabs.[149] These findings suggest that sites in the oral cavity may act as reservoirs of SARS-CoV-2 virus. The cellular viral targets required for infection by SARS-CoV-2, angiotensin-converting enzyme 2 (ACE2) and transmembrane serine protease 2 (TMPRSS) receptors, are broadly expressed in serous acinar and ductal epithelial cells of human PG and SMG.[150,151] In addition, SARS-CoV-2 has been found in both major and minor SG.[149] The detection of ACE2 expression in taste bud cells and throughout the oral cavity[152,153] indicates that many epithelial cells can be targeted by the virus and may explain the loss of taste, a frequently reported symptom in COVID-19 patients.[154]

Given these challenges, it is imperative to understand the infection risks and follow guidelines for effective preventive measures in dental practice.[136] Importantly, diagnostic markers for the detection of SARS-CoV-2 vary in a time-dependent manner.[155]

Owing to the delay between infection and onset of symptoms, infectivity should not be ruled out on the basis of RT-PCR tests alone.[143,155-157] Mask wearing reduces salivary droplet spread more than 10-fold.[149] The use of appropriate personal protective equipment combined with effective safety protocols significantly reduces the infection risk for dental health personnel.[158]

CONCLUSIONS

1. Advances in proteomics have expanded the understanding of the roles played by salivary proteins in taste, wound healing, and immune responses.
2. Technologies using saliva as a diagnostic fluid are rapidly being developed. Until recently, most commercially available detection platforms were enzyme-linked immunosorbent assay (ELISA)-based, but numerous devices for potential point-of-care screening and diagnostic systems[159-161] now enable detection of multiple targets within a saliva sample.
3. Given the central role that saliva plays in maintaining oral health and the advantages of using saliva as a diagnostic tool, a general knowledge of basic saliva physiology is important in clinical practice.

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