REVIEW ARTICLE

Saliva and its Importance

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ABSTRACT

Saliva has an old history of study but its physiological importance was recognised recently. In the past 50 years the pace salivary research has accelerated with the advent of new techniques that has illuminated the biochemical and physicochemical properties of saliva comprising the multifunctional roles that saliva has in speech, lubrication, digestion of food and maintaining oral and general health.

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INTRODUCTION

Human saliva mirrors our body's health and wellbeing. It is the principle defensive factor. Biomolecules that are circulating in blood are also found in human saliva. Saliva contains of approximately about 2,000 proteins, and most importantly, 26% of these proteins are also derived from blood. It harbours a wide spectrum of nucleic acids, electrolytes and hormones that originates from multiple local and systemic sources. This therefore emphasizes saliva's importance as another biological source for disease diagnosis and monitoring, as well as an ideal diagnostic medium to determine a person's response to treatment.

- 3 major salivary glands (paired)
  - Parotid
  - Sub mandibular
  - Sub lingual
- Minor salivary glands

  Saliva is a glandular secretion (exocrine) which continuously bathes the teeth and oral mucosa.
- Presence of saliva is vital to the maintenance of healthy oral tissue.

ANATOMY AND HISTOLOGY

All of the salivary glands develop in a similar way: Ingrowth of epithelium from stomatodeum extends deep into the ectomesenchyme and branches profusely to form the working parts of the gland.[1] Surrounding ectomesenchyme then differentiates to form the c.t. of the gland (capsule and fibrous septa). This takes place at 4-12 weeks of embryonic life. Parotids are the Ist and the sublingual and minor salivary glands are last to develop.

PAROTID – (SEROUS)

Largest, Wedge shaped. Base of wedge is superficial covered with skin, superficial fascia and parotid capsule. Situated in front of the ear, behind the ramus. Apex is the deepest part. Parotid duct is thick walled. It opens into the oral cavity in a papilla opposite the second molar tooth (Stensen's Duct)

SUBMANDIBULAR (MIXED)

Half the size of parotid. Its superficial part is between body of the mandible and the mylohyoid muscle. Deeper part lies above the mylohyoid. Thin walled duct. Empties into sublingual caruncle: Wharton's duct.

SUBLINGUAL - (MUCOUS)

Smallest, it is 1/5th of the size of submandibular gland. Lies in the floor of the mouth below the sublingual folds of mucous membrane. Made up of 30 smaller glands, which empty along sublingual fold in the floor of the mouth. Anterior sublingual gland forms a larger unit, which empties in 'Sublingual caruncle." Predominantly a mucous gland.

MINOR SALIVARY GLANDS (MUCOUS PREDOMINANT)

- Tongue, palate, buccal and labial mucosa
- Mucosal glands with mucous secretion.

STRUCTURE OF A SALIVARY GLAND

Working part of salivary glandular tissue

a. Secretory end pieces (acini)

b. Branched ductal system

Acinar cell arrangement

Serous	Mucous
• Roughly spherical form	• Tubular

• Intercellular spaces of (end pieces) acinar cells open into the lumen. This is start of ductal system.

3 types of ducts

Fluid 1st passes the intercalated ducts, lined by low cuboidal epithelium with a narrow lumen.Then it passes to striated ducts – More columnar cells with many mitochondria.Finally the excretory duct lined by cuboidal cells, except for terminal part which has stratified squamous epithelium.

The acinar cells may secrete mucous, serous or a mixture of both secretions. In mixed glands, mucous acini- capped with serous demilune

Myoepithelial cells surround the end pieces- assist in propelling secretions in the duct.

NERVE SUPPLY

Glands receive both, parasympathetic and sympathetic nerve supplies. Main control- parasympathetic. Its salivary nuclei is at juncture of pons and medulla.

Parasympathetic

Parotid	Sublingual and submandibular
• Inferior salivatory nerve	Superior salivatory nucleus.
Via- Glossopharyngeal nerve	Via- submandibular ganglion (Past ganglionic fibres)

• PALATINE GLANDS – inferior salivary nucleus Via pterygopalatine ganglion

SYMPATHETIC

• From superior cervical ganglion and reaches the glands via- External carotid nerves

BLOOD SUPPLY

Blood supply influences secretion. More blood supply, Increased rate of salivary secretion. Concentration of capillaries – striated ducts where ionic exchange takes place. Lesser capillaries at terminal parts. Salivation- indirectly dilates blood vessels- increase in nutrition. The blood vessels are supported in the connective tissue stroma.[2]

FACTORS INFLUENCING SALIVARY FLOW RATE

Unstimulated Saliva

Secreted Continuously in absence of exogenous stimulation composed of – secretions from minor and major salivary glands, GCF, desquamated epithelial cells, bacteria, leucocytes, food residue, blood and virus.

Factors affecting its flow rate

1. Degree of hydration – when body H_2O content is below 8%, salivary rate flow becomes zero.
2. Body posture and light
   Standing > Lying > Sitting less in flow rate in the dark
3. Biological rhythms
   Saliva flow peaks at late afternoon (acrophase) and drops to almost zero at night. Thus it is important to brush at night as presence of plaque, food debris and decreased saliva are optimum conditions for dental caries. Saliva flow increased in winter
4. Psychic stimuli
   Thought and sight of food are poor stimuli. Its only that are becomes more aware of the pool of saliva in the floor of the mouth
5. Drugs
   Many drugs decrease salivary flow as their side effects. They are centrally or directly on the glands.

STIMULATED SALIVA

In response to masticatory or gustatory stimuli

Factors affecting flow rate:

1. Mechanical stimuli – More salivation on
   - Chewing action (even absence of taste)
   - Mastication
   - Mechanical stimulation of fauces (gag reflex)
2. Vomiting- increases salivary flow prior and during vomiting
3. Gustatory and olfactory stimuli
   Saliva flow with acids> Salts> bitter> sweet.
   Olfactory stimuli and tobacco smoking have small effects.
4. Unilateral stimulus
   If unilateral chewer – greater saliva produced on that side
5. Gland size: maximum stimulated flow rate from single gland a gland size. However unstimulated flow is independent.
6. Age- unrelated to age above 15 years.
   It does not decrease with age. But as elderly people are on medication, tendency for decrease in salivary flow is greater.
7. Food intake:
   Bland food- 43% max flow rate. Pie (ac9d9c and sweet) – 70% max flow rate. Chewing gum- initially increases salivary flow for Ist 10 minutes. Then decreases to 2-3 times of unstimulated flow rate. Normal rate of flow or unstimulated. Whole saliva (UFR) – 0.3 ml/ min. And or stimulated whole saliva (SFR)- 1-2 ml/ min.Daily flow

of whole saliva – 1-1.5 L. Unstimulated flow- 20% parotid, 65% submandibular, 8% sublingual Rest – minor glands. Stimulated flow- Parotid flow 50%.

Composition

Average composition of mixed human saliva
Water – 99.4%
Solids – 0.6%
Sp. Gravity 1.002 – 1.008
Average pH 6.7
pH range 6.2 – 7.6

Inorganic substances- (electrolytes)

Sodium	magnesium
Potassium	Bicarbonates
Calcium	Phosphates
Fluoride	Chloride

Organic substances

Urea	Glucose
Uric acid	Lactate
Amino acids	Fatty acids

Macromolecules

Proteins	IgA
Glycoproteins	Igb
Anylase	IgM
Lysozyme	IgM
Peroxidase	Lipid

FUNCTIONS

1. Fluid/ Lubricant- Coats mucosa, protects against mechanical, thermal, chemical irritation. Assists smooth air flow, speech and swallowing
2. Bicarbonates, phosphates and urea- Nodular pH and buffering capacity. Thus neutralises pH of plaque.
3. Macromolecule proteins and mucins- Helps to cleanse, aggregate and/ or attach oral micro-organisms which contribute to plaque.
4. Calcium phosphate and proteins
   antisolubility, factor
   Modulate demineralization and remineralization
5. Immunoglobulins, proteins and enzymes
   antibacterial activity
6. Salivary proteins-
   Digestive process. (Amylase)
7. Taste- Saliva acts as a solvent, allowing the interaction of food with taste buds.
8. Excretion – insignificant
9. Water balance – if dehydration – less salivary flow more urine production and more water intake

LUBRICATION AND PROTECTION

Seromucous coating which acts as a barrier against irritants. Mucins- minor salivary gland: major role - Aids in mastication, speech and swallowing. Also have antibacterial function – selective modulation of adhesion of microorganism to oral tissue surface. Different molecular wt. Mucin from sublingual and submandibular gland is produced.Both these mucins help to form enamel pellicle. Protects tooth from acid challenges. Initiate bacterial colonization – protective barrier and lubrication against wear. Barrier against acid penetration. Limits egress of minerals from tooth surface.

BUFFERING ACTION AND CLEARANCE

Bicarbonates, phosphate, urea, Amphoteric proteins and enzymes. Bicarbonate- most important. Diffuses into plaque- Neutralizes acids – NH_4- amines- Neutralize acids. Buffering action – effective during stimulated flow. Ineffective during low flow of unstimulated saliva. Remaining fermentable carbohydrates + buffering capacity of saliva affect plaque pH. Resting pH of plaque – 6-7. PH more during the first 5 min after eating. Then falls to 6.1 15 min later, after food consumption. The pH is slowly got back to the resting pH. Thus salivary buffering, clearance and flow rate work in concert to influence intra oral pH.[3]

MAINTAINING TOOTH INTEGRITY

Facilitates demineralization and remineralization. Acid – plaque + pellicle Enamel crystals- dissolution at 5- 5.5 pH. (demeralization). Dissolved substances diffuse out of tooth surface – saliva – buffering action – inhibits caries. Remineralization – Replace lost minerals through organic matrix of the enamel. Supersaturation of minerals is critical. High concentration of calcium and phosphate- help in maturation and remineralization of enamel. Presence of fluoride speeds up crystal precipitation. Fluorapatite like coating.[4,5]

XEROSTOMIA

Accompanied by salivary gland hypofunction (SHE) + severe reduction of unstimulated saliva. UFR (normal 0.3 ml/ min) falls below 50% subjects. Complain.

Causes

1. Water/ Metabolite loss
   - Dehydration
   - Less water intake
   - Loss of water through skin
   - Blood loss
   - Emesis

- Diarrhoea
- Renal water loss
- Protein calorie malnutrition

2. Damage to salivary glands
   - Irradiation to head and neck region
   - Autoimmune disease e.g. Sjogren's syndrome
   - HIV
   - Ageing?
3. Interference with neural transmission
   - Drugs
   - Autonomic dysfunction
   - Conditions affecting CNS (Alzheimer's disease)
   - Psychogenic disorders
   - Trauma
   - Less mastication.

SIGNS AND SYMPTOMS – CLINICAL

Less protective functions of saliva, more dental decay, rampant caries, less oral clearance and dysphagia, candidiasis, buccal mucosa – pale, Tongue – lobulation/ fissuring

Symptoms

Less in amount of saliva, it is foamy, viscous ropy, lips Dry, cracked, fissured, tongue- Burning and glossodynia, cheeks – dry, salivary gland- swelling, pain, thirst, mastication – difficulty in eating any food difficulty in using denture, swallowing – dysphagia, speech dysphonia, taste – Dysgensia.[6]

MANAGEMENT – XEROSTOMIA

Patient education, patient generally stops chewing and prefers liquid diet. Patient should be advised to chew. As periodontal mechanoreceptors and mechanical stimulation of tongue and oral mucosa increases salivation. Drugs should be avoided at bed time as there is less salivary flow. Timing of dose should be changed. Patient has less acceptance to dentures. Less saliva causes irritation of the mucosa (dry and fragile). Incorporation of salivary reservoirs in dentures. Use of resilient liners is very helpful. Minimize denture use. At night dentures must be soaked in water. The tissue surface of the denture can be sprayed through out the day with artificial saliva. Dry mouth, more chances of oral thrush.[7]

SALIVA – APPLIED PROSTHODONTICS

The amount and consistency of saliva affects denture construction and quality of final product.

- Consistency of saliva ranges from
  - Thin- serous type to
  - Thick- Ropy

If less saliva – less retention of denture. Excessive saliva, particularly submandibular and sublingual glands, complicates impression making. Treatment atropine sulphate can be given orally before the procedure. More mucous secretions – palatal glands – distort impression material in posterior 2/3 of palate. Treatment – Palate can be massaged – helps to empty gland. Wipe palate with gauze. Rinse with astringent mouth wash.

Excessive salivary flow- Insertion of new dentures. Viscous / Ropy saliva – less retention – more frictional trauma to thin mucosa. Presence of thick, ropy saliva creates problem for maxillary complete denture retention. Thick saliva can create hydrostatic presence in the anterior area anterior to PPS, resulting in downward dislodging force on denture base. To overcome this- a fine line or lipid's bow is scribed on the master cast, anterior to the cluster of palatal mucous glands. Thin extension of the posterior palatal seal line will contain thick mucous in the posterior part of the denture and provides a seal even if the posterior portion of denture base is slightly out of contact with the palatal tissues.[8-10]

Often the palatal glands are destroyed in patients wearing maxillary CD for many years, due to presence of presence of presence atrophy resulting from cost residual ridge. Dentures

Salivary Substitutes		
Type of product	**Brand Name**	**Select characteristics**
I Mechanical (Masticatory) (Apples, carrots, hard bread, meat etc)		
Sweetness	Biotene Eclipse Extra	Xylitol Maltitol, Sorbitol, Mannitol, Aspertame Sorbitol, Mannitol, Maltitol, Aspertame,
Sugarless Gums	Orbit white Xylifresh air waves	Maltitol, Sorbitol, Mannitol, Aspertame Xylitol Sorbitol, Mannitol, Maltitol (Syrup in honey), aspartame
Sugarless tablets	Salix	
Chemical Stimulants		
Solutions	Optimoist	Contains citric acid
Electrical stimulants		
Electrical stimulation	Salitrol	Intra oral electronic stimulator of saliva
Pharmacological stimulants		
Drugs	Salagen	(Piloearpine HCL) – Cholonergic agonist

made from mucostatic impression tends to break the secretary capacity of palatine glands quicker than other methods. Profuse salivation hampers the insertion of operative restorations and cementation of crowns and bridges. Isolation of the operating field.[11]

I Local anesthetics
Less salivary flow
II Rubber Dam
III High volume evacuators
- Saliva ejectors
IV Absorbents and throat shields
- Cotton roll isolation
V Alternatives
- Retraction cord
- Mirror and evacuator tip retraction
- Mouth prop
- Drugs – atropine.

SALIVA AND DENTURE RETENTION

Retention

The quality inherent in the prosthesis which resists the force of gravity, adhesiveness of food, and forces associated with the opening of the jaw.[12,13] Saliva is considered as a major factor for physical influences that contribute denture retention.

These are

a. adhesion
b. Cohesion
c. Capillarity
d. Atmospheric pressure

INTERFACIAL SURFACE TENSION

Results from a thin layer of fluid which is between 2 parallel planes of rigid material. The thin fluid film between the denture base and mucosa of basal seat- retentive force by virtue of fluid (Saliva) to maximize its contact. Capillarity- Causes liquid to rise in a capillary tube, liquid rises along the tube at interface between liquid and air. When the adaptation of the denture base to the mucosa is close- the saliva in this space is a thin film – acts capillary tube- saliva tries to increase its contact with the denture and mucosal surface- Helps retention. Interfacial surface tension – major role for maxillary dentures.

Interfacial viscous tension: The force that holds 2 parallel plates together, due to the viscosity of the interposed liquid.[14]

Stefan's law

$$F = \frac{(3/2)\, \pi\, Kr^4}{h^3} V$$

R – Radius of the 2 parallel circular plates
K – Newtonian liquid of viscosity
H – Thickness of liquid
F – Force to pull plates apart at
V – Velocity.

When applied to denture retention –

- Optimal adaptation of usual seat to denture (minimal G)
- Minimize surface area covered (r)
- If more in viscosity of saliva – more retention
- Slow, steady displacing action – encounters less resistance in removing denture. (Small v)

Adhesion

Physical attraction of unlike molecules.

Achieved by charged forces of salivary glycoprotein and surface epithelium. Thus contact of saliva to oral tissues and denture base enhances further retention.

Cohesion

Physical attraction of like molecules for each other.

Occurs within the layer of saliva, between basal seat and denture base – and maintains integrity of the interposed film. Normal saliva is not very cohesive. Thick high mucin saliva- more viscous than thin watery saliva. Yet thick secretions don't result in increased retention because, watery (serous) saliva can be interposed in a thinner film than the more cohesive mucin secretion.[15]

Saliva and oral galvanism

The electrolytic action between two metals or alloys in the mouth is due to the presence of continuous renewal of saliva. Thus part f the metal gradually corrodes.[16] This is accelerated by the presence of another metal even if they are not in contact. This causes discolouration of metal restoration. These products are posed into saliva and washed off by saliva, and some are swallowed. This may have a toxic effect. The strength of the current increases with the acidity of saliva. Order in which (ascending) the metals corrode.

$Al^{3+} > Zn^{2+} > Fe^{2+} > Ni^{2+} > Sn^{2+} > H^{+} > Cu^{+} > Ag^{+} > Hg^{2+} > Pd^{2+} > Pt2^{+} > Au^{+}$

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