Role of Saliva: An Orthodontic Perspective

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Introduction of Saliva

Saliva is clear viscous fluid secreted by the salivary and mucous glands in the mouth. Saliva contains water, mucin, organic salts and the digestive enzyme ptyalin. It serves to moisten the oral cavity, to aid in the chewing and swallowing of food and to initiate the digestion of starch[1].

Anatomy of Salivary Glands

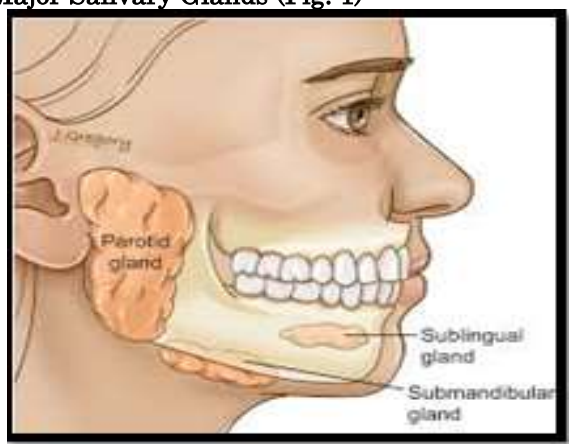
Salivary glands are defined as **compound**, **tubuloacinar**, **merocrine**, **exocrine** glands whose ducts open into oral cavity[2].

Classification of Salivary Glands

Salivary glands is classified as follows[3]

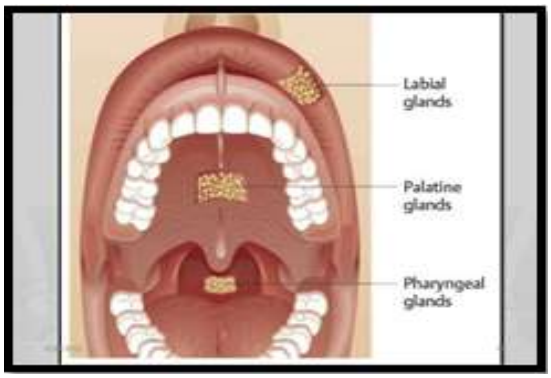
- ✖ According to size of the glands as:
- \+ Major
- \+ Minor
- ✖ According to histo-chemical nature of secretion:
- \+ Serous
- \+ Mucous
- \+ Mixed
- ✖ According to position:
- \+ Extraoral
- \+ Intral oral

Major Salivary Glands (Fig. 1)



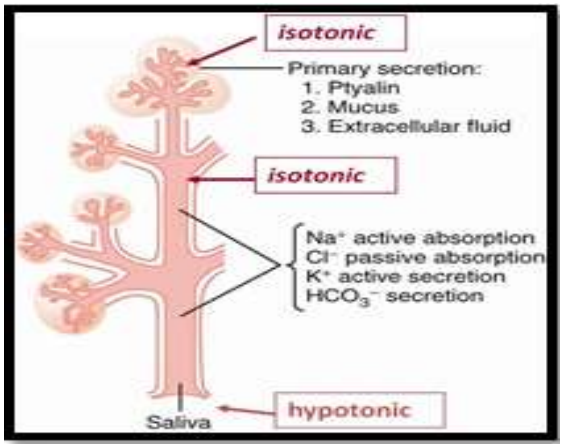
1. Parotid Gland
2. Submandibular Gland
3. Sublingual Gland

Minor Salivary Glands (Fig. 2)



1. Labial and buccal glands
2. Glossopalatine glands
3. Palatine glands
4. Lingual glands

Mechanism of Secretion of Saliva (Fig. 3)



Nerve to gland stimulated
⇩
Release of neurotransmitters
⇩
Binding of NT on external surface of membrane
⇩
Receptors on External membrane
⇩
Guanine nucleotide dependant membrane protein (G-protein)

Phospolipase C — Regulatory Enzyme — **Adenyl cyclase**

Salivary Secretion

1. Spontaneous: Occurs all the time, without any known stimulus. This keeps mouth moist all the time.
2. Stimulated: Occurs because of known stimulus; may be

+ Psychological
+ Visual
+ Taste
+ Others (during vomiting)

Salivary Flow

✖ **Under resting condition**
+ Anything above 0.1ml/min
+ Slow flow of saliva - Keeps mouth moist and lubricates mucosa
✖ **Under stimulated condition**
+ Above 0.2ml/min with max 7ml/ min
✖ **During sleep—Nearly zero**

Properties of Saliva

✖ Colourless
✖ Volume :- 1000 – 1500 ml per day
✖ Reaction:- In healthy individuals varies between 6.0-7.5
✖ Specific gravity:- 1.002-1.012
✖ Tonicity-: Hypotonic as compared to plasma

Composition of Saliva (Fig. 4)

A. Organic substances :-

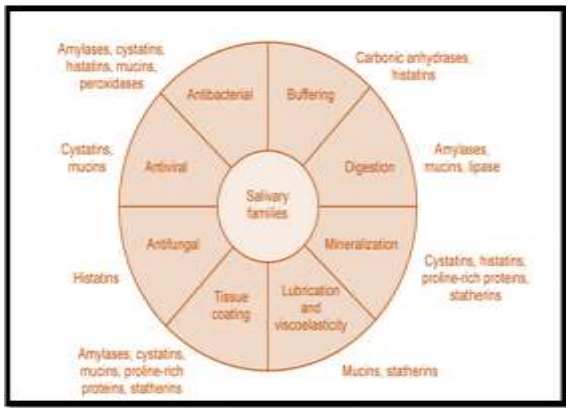
+ Salivary protein – mucin and albumin
+ Salivary enzymes – amylase (ptyalin) maltase, lipids, lysozyme, phosphatase, lactoferrin, sialoperoxidase and carbonic anhydrase
+ Kallikrein
+ Blood component and blood derivatives – antigens, serum cells, gingival cervicular fluid (GCF)
+ Immunoglobulins – IgA, IgG, IgM
+ Non protein nitrogenous substances – urea, uric acid, creatine, xanthine, hypoxanthin etc.
+ Free amino acids
+ Glycoproteins and proteoglycans

B. Inorganic substances

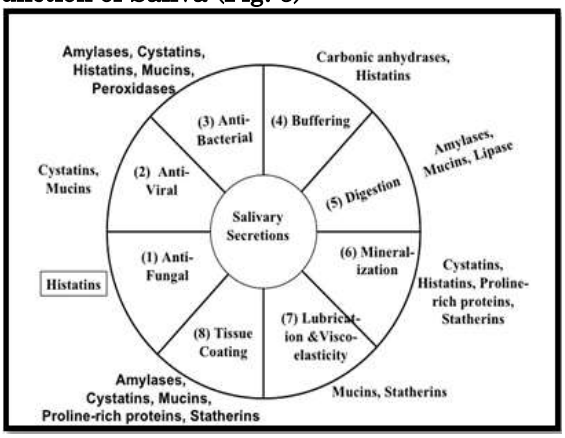
+ Sodium
+ Potassium
+ Calcium
+ Chloride
+ Bicarbonate
+ Fluoride
+ Bromide
+ Phosphate
+ Thyocynate

C. Gases present in saliva

+ Oxygen – 1 ml
+ Carbondioxide – 50 ml/10ml
+ Nitrogen – 2.5 ml



Function of Saliva (Fig. 5)



Applied aspects of saliva in orthodontics

Saliva and Bonding (Fig. 6)

- ✖ Saliva is detrimental to adhesive bonding.
- ✖ Salivary contamination during acid etching or actual bonding procedure jeopardizes the chance of a successful bond through precipitation of salivary proteins, which may physically clog and/or chemically react with the etched enamel surface
- ✖ Ever changing influence of saliva in bonding procedure with advent of new generation of bonding agents, primers.
- ✖ Bond strengths of brackets bonded to contaminated and uncontaminated enamel following pretreatment of contaminated enamel with Scotch bond MP (multi-purpose) bonding system.
- ✖ Bond strengths were found to be equal in brackets bonded to saliva contaminated etched enamel treated with Scotch Bond MP primer and bonding agent applied to uncontaminated enamel.
- ✖ The primer composed of Hydroxy Ethyl Methacrylate and polyalkeonic copolymer behaves similar to the liquid of glass ionomer in that it forms stronger bonds to a moistened enamel or dentin surface.
- ✖ Effect of blood and saliva contamination on the shear bond strength of 4 orthodontic adhesives :
- ✖ Transbond XT primer
- ✖ Transbond Plus self-etch primer
- ✖ Assure hydrophilic primer
- ✖ SmartBond cyanoacrylate.
- ✖ The shear bond strength of the Smart Bond cyanoacrylate adhesive group was significantly lower than all other groups; however, it was the only adhesive that was not affected by contamination.
- ✖ Saliva and blood contamination resulted in significant drops in shear bond strengths of the Transbond XT and Assure groups.
- ✖ Transbond Plus self-etch primer was also negatively affected by blood contamination, although it was suitable for bonding with saliva contamination[4,5,6].

Isolation[7,8]

Fluid absorbents:

- ✖ Isolation achieved by absorption of salivary secretions.
- ✖ Can be used for short periods when absolute dryness is not required
- \+ Cotton rolls with holders
- \+ Gauze or throat shields
- \+ Absorbent wafers
- \+ Dri-Angle

Saliva ejectors (Fig. 7):

Prevent pooling of saliva in the floor of the mouth.

- ✖ Types
  - \+ High volume
  - \+ Low volume
- ✖ Based on the material from which they are manufactured
  - \+ Metallic
  - \+ Plastic

Rubber Dam[9] (Fig. 8):

- ✚ Provides a clean, visible field
- ✚ Prevents aspiration of foreign bodies
- ✚ Reduces risk of cross contamination.
- ✚ Improves properties of adhesive materials.
- ✖ **Indications**
- ✚ Molar Banding
- ✚ Bonding procedures
- ✚ Debonding procedures
- ✚ Bonding lingual retainers
- ✖ **Contraindications :**
- ✚ Patient with upper respiratory tract infection
- ✚ Asthmatics
- ✚ Allergy to latex
- ✚ Partially erupted tooth.

Anti-sialogogues[10]

- ✖ **Decrease salivary release from glands & ducts**
- ✚ Atropine sulphate- In JCO-1981 Sidney Brant showed this is a safe drug with least complications & can be used as an sublingual injection
- ✕ Dose-0.4 mg
- ✚ Banthine tablets –In JCO 1981 Carter RN reported that 50 mg per 100 lb in a sugar free drink 15 min before bonding is adequate.

Saliva and Friction[11,12,13,14,15,16]

- ✖ The influence of saliva on the observed friction in an orthodontic system seems quite elusive.
- ✖ Baker et al. observed decreased friction in presence of artificial saliva
- ✖ Stannard JG et al. have shown increased friction in presence of artificial saliva
- ✖ Ireland AJ et al. and Riley JL et al. have shown no significant differences between wet and dry conditions
- ✖ At low loads saliva may act as a lubricant, but at high loads saliva may increase friction if it is forced out from the contacts between the brackets and the arch wire. In the latter situation, saliva may produce shear resistance to sliding forces.
- ✖ Kusy has shown that, when saliva is present, frictional forces and coefficients may increase, decrease, or not change depending on the arch wire alloy tested.
- ✖ In the wet state, the kinetic coefficients of the all-stainless steel combinations increased up to 0.05 over the dry state.
- ✖ In contrast, all beta-titanium wire combinations in the wet state decreased to 50% of the values in the dry state.
- ✖ The composition of the saliva appears important with regard to ceramic brackets; in artificial saliva the friction increased whereas in human saliva it decreased.

Salivary clearence and fixed appliance[17] (Fig. 9)

- ✖ Since fixed appliances have numerous recesses, pits, which entraps the food particles, oral clearance rate is slowed
- ✖ A study
  - ✚ Both RESID (residual volume of saliva in the mouth after swallowing) and salivary flow rate exhibited significantly increased levels during orthodontic therapy. The insertion of fixed appliances did not seem to have any effect on the rate of salivary clearance of sugar.
- ✖ Further studies with longer duration claimed to have decreased or normal levels of salivary flow and RESID.

Salivary pellicle on orthodontic appliance[18] (Fig. 10)

- Knowledge of salivary pellicles on orthodontic brackets provides a better understanding of microbial adherence.
- In a study by Ahn SJ et al the authors showed that low-molecular-weight mucin, alpha-amylase, secretory IgA, acidic proline-rich proteins, and cystatins adhered to all kinds of brackets, though the amino acid composition of pellicles differed between bracket types.
- Collectively, salivary pellicles were found to play a significant role in the initial adhesion of oral streptococci to orthodontic brackets.
- Least amount of salivary pellicle which was cariogenic was found on stainless resin, followed by adhesive resin, highest amount of cariogenic pellicle was found on elastomers.

Saliva and orthodontic elastics[19,20,21] (Fig. 11)

- Tong Wanga et al **e**valuated the characteristics of force degradation of latex elastics in clinical applications and in vitro studies.
- At 24- and 48-hour time intervals, the force decreased during in vivo testing and in artificial saliva, whereas there were no significant differences in dry room conditions.
- In a study by Ferriter JP et al. the authors concluded that force decay rate of polyurethane orthodontic chain elastics is inversely proportional to the pH of oral environment
- The pH levels of **4.85 to 7.26** are more hostile to the polyurethane chain elastics thus increasing their force decay rates.

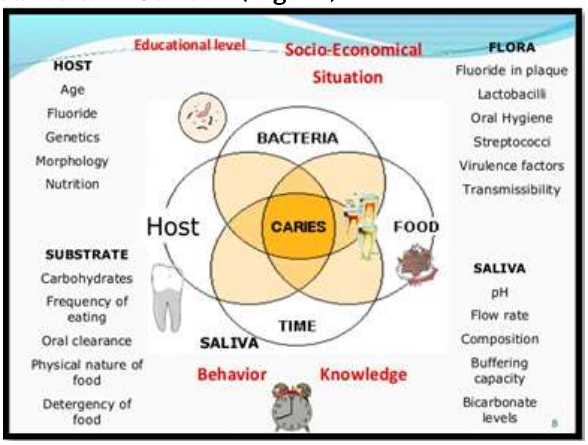
Saliva and Corrosion[22]

- Saliva acts as an electrolyte and hence aids in causing corrosion of metal components of fixed orthodontic appliances
- Orthodontic alloys emit electro-galvanic currents with saliva as the medium, leading to a release of metal ions.
- The discharge of nickel ions, a strong immunologic sensitizer may result in hypersensitivity, contact dermatitis, asthma, and cytotoxicity.
- Matos de Souza R et al assessed the in vivo release of nickel, chromium, and iron ions into saliva by different metallic brackets.
- Nickel and chromium ion concentrations increased immediately after placement of the appliance in the mouth for all study groups.

Morphological parameters of the saliva in patients undergoing orthodontic treatment

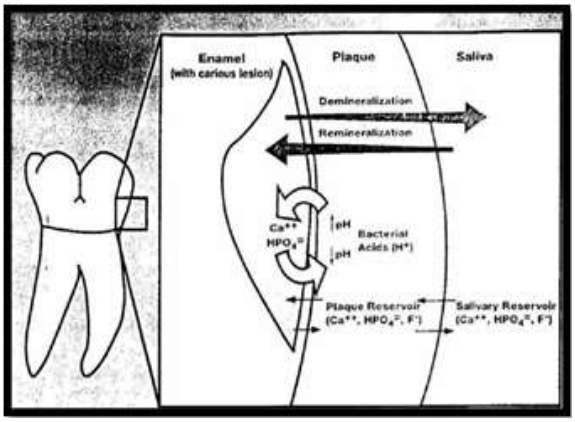
- Orthodontic patients develop changes in the composition and morphology of salivary cells, the intensity of which depends on the time of exposure to the appliance.
- The longer the treatment continues, the slighter the metal-induced histo-pathological changes; this inturn suggests that mechanisms of oral tolerance might develop.

Saliva and Caries[23] (Fig. 12)



- The pH of saliva acts as a deciding factor, be it demineralization and induction of carries or remineralization.

Demineralization-remineralization cycle (Fig. 13)



Barrier control for saliva[24]

- ✖ The objective of barrier control is to eliminate cross-contamination
- ✖ Barriers are the most effective way to control cross-contamination and reduce the number of microbes in the orthodontic office.
- ✖ Include
- ✖ Gloves
- ✖ Masks
- ✖ Protective clothing,
- ✖ Protective eyewear
- ✖ Surface coverings,
- ✖ Disposable materials.

Conclusion

- ✖ Saliva is probably the most important environmental factor affecting the performance of the orthodontic appliances, affecting their success or failure.
- ✖ Understanding the role of saliva in various pathological processes as well as orthodontic procedures can go a long way in improving the quality of treatment.

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