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REVIEW ARTICLE

SALIVARY SUBSTITUTES IN PROSTHODONTICS

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ABSTRACT

Saliva constitutes an important role in maintaining the health of the oral cavity. It helps in lubrication, mastication, and has effective antimicrobial action. In prosthodontics, saliva plays a main role in retention of the denture. Hyposalivation is a main complication in diabetes, radiotherapy, chemotherapy, sjogren syndrome, certain systemic conditions and patients with maxillofacial defects. Pharmacotherapy is the initial management to increase the salivary flow. Cholinergic drugs are administered systemically to increase the salivary flow. However, in extreme cases salivary substitutes are used to maintain and increase the salivary flow. This article is about the role of salivary substitutes to modulate salivary flow to enhance prosthodontic success.

INTRODUCTION

Xerostomia is defined as drymouth resulting from reduced salivary flow. It can affect nutrition, dental and psychological health. If xerostomia left untreated decreases the pH in oral cavity and leads to plaque and dental caries. Oral candidiasis is one of the most common oral infection seen in associated with xerostomia. Dentures which would ordinarily rehabilitate the edentulous patients are often poorly tolerated in such patients. Saliva forms a thin film between denture and the oral cavity and its absence lead to decreased retention and increased chances of ulceration in oral mucosa. Denture wearers have problems in denture retention, denture sores and the tongue sticking to palate. Current treatment approaches for management of xerostomia are directed toward providing relief of symptoms and resulting conditions. They include gustatory, masticatory and pharmacological stimulants, replacement therapies and prevention effects on oral health due to xerostomia.

Pharmacotherapy for hyposalivation

Drugs have an important role to increase the salivary secretion. Drugs can be a first line of choice of treatment to increase the salivary secretion and flow. To increase the salivary flow, drugs activate muscarinic and cholinergic receptors of parasympathetic nervous system. Pilocarpine hydrochloride and cevimeline hydrochloride have short duration effect in salivary flow without any side effects. Salivary substitutes contain either carboxymethylcellulose or hydroxyethylcellulose as lubricants and variety artificial sweeteners, fluoride salts, preservatives and chloride (Jagadeeshwaran et al., 2012).

Oral Pilocarpine is a parasympathomimetic medication with muscarinic action. Cevimeline is a salivary gland stimulant with a stronger affinity for M3 muscarinic receptors. Pilocarpine is administered at a dose of 5mg three times a day for at least 3 months and cevimeline is prescribed at a dose of 30mg three times a day for at least 3 months.

Composition of salivary substitutes used in prosthetics

Sodium carboxymethylcellulose, sorbitol, potassium chloride, sodium chloride, magnesium chloride, calcium chloride, dipotassium hydrogen orthophosphate, potassium di-hydrogen orthophosphate, sodium fluoride, methyl p-hydroxybenzoate, spirit of lemon (Jain. M *et al.*, 2012). These are composition of artificial saliva used in prosthetics.

Commonly used salivary substitutes in prosthetics

To produce artificial saliva with properties comparable to natural saliva mostly salivary glycoproteins replaced with carboxymethylcellulose. Salivary substitutes containing polyethylenoxide has high viscosity, elasticity and adhesiveness (Vissink.A *et al.*, 1984). Saliva orthana spray, saliva orthana gel, salivix pasties, salivace, glandosane, moisties, commonly available salivary substitutes (Smith, G *et al.*, 2001). Artificial salivary are usually based on cellulose derivatives which exhibit near Newtonian viscosity in solution in the concentration which have been used (Marks.N.J *et al.*, 1983).

Development of salivary substitutes

First generation artificial saliva

The first generation artificial saliva involves protein conditioning of intra oral surfaces. Examples include histatins

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and statherin. It is achieved by using NMR and X-ray crystallography.

Second generation artificial saliva

Second generation artificial saliva will be developed in the laboratory. Second generation chimeric molecules could be designed that possess multiple function. It is cistatin/ histatins fusion protein. Second generation salivary molecule have broadened antimicrobial spectrum. One portion is protease inhibitor to protect an antimicrobial domain from exogenous proteolysis. Another example is proline/histatins rich protein chimeric that has a candidacidal component while the proline-rich protein serves as a substrate for mucosal attachment via an epithelial transglutaminase. A third type of second generation artificial saliva might be comprised of synthetic peptides that mimic the shape of conformation of bioactive carbohydrate domains. Such peptides might be used to modulate the oral flora in individuals prone to a high level of plaque mediated diseases. The second generation artificial saliva substitutes will have to address several biological considerations. (Levine *et al.*, 1993)

Rheological properties of salivary substitute

Rheological properties of salivary substitute should stimulate human saliva. During swallowing and speaking the shear rate of salivary substitute should be 60 s and 160s. At this value the viscosity is low, limiting the appearing shear rate to an acceptable value. In crevices between the teeth saliva will be subjected to very low shear rate and subjected to large viscous contribution may be of great importance in any cleansing process. Viscosity is inversely proposed to diffusion and coefficient. This is important in fixation of dentures. For this reason the rheological properties of salivary substitute should stimulate human mixed saliva. According to a study conducted in salivary substitute using tensinometric and ellipsometric the viscosity of the salivary substitutes can be in the range of 5-25mpas. Surface tension for the salivary substitute gradually decreases with time. (Christersson *et al.*, 2000)

Biological considerations for designing salivary substitute

Artificial salivary molecule should have mechanism of interaction towards intraoral surface similar to salivary molecule. Salivary substitute has interaction towards enamel, dentin, and microorganism. It should specifically interact with microorganism. For example proline rich glycoprotein interacts with streptococcus gordonii. Artificial salivary substitute should have three dimensional structures to maximize the biological activity of intraoral surface.

Antimicrobial effects of salivary substitute

Salivary substitute has antimicrobial effects in oral mucosa in xerostomia, radiation therapy, hematopoietic cell transplantation, end stage renal disease patient. Oralbalance gels have antimicrobial effect and alleviate symptoms of dry mouth (Shah *et al.*, 2015). Oralbalance gel has antimicrobial effects against *S.sanguis*, *S.salivarius*, *N.mucosa*, *S.mucilaginosus*, *S.epidermidis*, and *S.aureus* and *C. albicans*. In neutropenic patient coagulase negative staphylococci is isolated from blood culture. Oral mucosa is potential source for

this organism. Oralbalance gel reduces this organism in oral mucosa. Antimicrobial effect of Oralbalance is due to the presence of antimicrobial enzyme such as lactoperoxidase, lysozyme and lactoferrin. Oralbalance gel does not have any antibiotics. It does not contribute to the appearance of antibiotic resistant bacteria. Antimicrobial effects of normal saliva depend on lysozyme and peroxidase activity. Peroxidase provides antimicrobial activity and protection of oral tissues through consumption of hydrogen peroxide. In artificial saliva hen egg white lysozyme and bovine lactoperoxidase molecule has been incorporated to obtain antimicrobial activity. (Kho *et al.*, 2009)

Remineralisation effect of salivary substitute

Salivary substitute has remineralisation effect on tooth. Salivary substitute Oralube has fluoride content. Regarding hydroxyappetite this composition leads to remineralisation of the lesion. Remineralisation effect is found mostly in carboxymethylcellulose than mucin based salivary substitute. It depends on viscosity of saliva. Lower the viscosity higher the remineralisation effect. By increasing calcium in mucin based salivary substitute remineralisation of salivary substitute will increase (Kielbassa, A.M. *et al.*, 2001). Saliva natura is a salivary substitute has demineralization effect on dentin but it has neutral effect on enamel. By adding calcium, phosphate, fluoride in saliva natura leads to remineralisation effect. Remineralisation effect of salivary substitute prevents caries in hyposalivation patient better than fluoride gel and mouth rinses. (Kho *et al.*, 2009)

Demineralization effect of salivary substitute

Demineralization depends on pH value of the salivary substitute. The pH value for saliva glandosane is around 5.1. It damages the sound enamel structure (Kielbassa *et al.*, 2001). Saliva orthana spray, salivix, Saliva orthana lozenge has low demineralization capacity. To prevent demineralization effect salivary substitutes in combination with fluoride can use. (Kho *et al.*, 2009)

Film forming properties of salivary substitute

Film forming properties of salivary substitute have high clinical impacts than viscosity alone. Saliva orthana, salinum, have viscosities exceeding that of whole saliva. In addition to this it possess intersurface film at solid/liquid air/liquid interfaces. (Christersson *et al.*, 2000)

Salivary substitutes in prosthetics

Retention is the resistance of denture to removal in a direction opposite to that of insertion. Retention of a denture depends on various factors such as adhesion, cohesion, interfacial surface tension and saliva. Saliva plays an important role for these factors to be effective. To overcome hyposalivation, salivary substitutes are utilized. Salivary substitutes contain agents for moistening, and lubrication for oral surfaces. Salivary substitutes are available as solutions, sprays, or gels. Salivary substitutes are delivered through salivary reservoirs. Salivary reservoir is a chamber incorporated into a removable prosthesis that provides a flow of salivary substitutes for a certain period of time. Salivary substitutes preserve the underlying mucosa

beneath the intaglio surfaces of the prosthesis by flushing the food debris collected due to xerostomia and also reintegrates the health of denture bearing mucosa by its nutritive and healing properties.

Uses of salivary substitute

It plays main role in xerostomia patients wearing dentures. Salivary substitute helps in retention of denture in patients with xerostomia. In end stage renal disease patient salivary substitute reduce thirst and dry mouth. Salivary substitutes have a substantial effect on radiation therapy patient and sjogren syndrom. (Bots *et al.*, 2005). Lozenge form polyethylene oxide reduces dry mouth in xerostomia patient. It has beneficial effects on dry mouth. Even when the lozenge gone polyethylene oxide remains and gets reactivated after drinking water. The spray form of xylitol has lubricating effect on oral mucosa. (Silvestre *et al.*, 2009) Salivary substitute contain fluoride has significant effect in remineralisation, caries prevention, attrition of enamel. Salivary substitute has antimicrobial activity. So it is used in patient with hematopoietic cell transplantation patient and neutropenic patient.

Indications

Full mouth prosthetic and restorative rehabilitation for radiotherapy, chemotherapy, xerostomia patient. Drymouth and throat management in xerostomia and hyposalivation caused by stroke, medications, chemotherapy, radiotherapy, HIV, sjogren syndrome, Bell palsy, lupus aging, salivary gland disorders, pharyngitis.

Contraindications

Salivary substitutes like carboxymethylcellulose parabens components are contraindicated in patient with hypersensitivity, renal failure, HF, hypertension, and pregnancy. Pilocarpine is contraindicated in asthmatic patient.

Side effects

The commonly observed side effects are itching, tingling sensation, swelling of mouth and face.

Conclusion

Many protective functions of saliva can be attributed to the biological, physical, structural and rheological characteristics of saliva glycoproteins. Artificial salivary substitutes with its biological, rheological properties can be a great adjunct influencing success of prosthodontic treatment by restoring the health of dehydrated mucosa.

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