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SALIVA: THE SILENT PILLAR OF PROSTHODONTIC SUCCESS

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ABSTRACT

Saliva is a multifaceted biological fluid essential for maintaining oral and systemic health. Its biochemical, mechanical, and immunological properties are critical in prosthodontic practice, influencing denture retention, mucosal protection, taste perception, speech articulation, hygiene, and implant integration. This review explores the anatomical and physiological foundations of saliva and its implications in prosthodontics. Particular attention is given to clinical challenges in xerostomia, prosthetic material selection, and implant-supported prostheses. Management strategies for altered salivary conditions are discussed. A comprehensive literature review of PubMed and Medline databases forms the foundation of this review to assist clinicians in optimizing oral rehabilitation outcomes.

KEYWORDS: Saliva, Xerostomia, Biofilm, Hydrophilic Denture Base Material, Digital Sialometery.

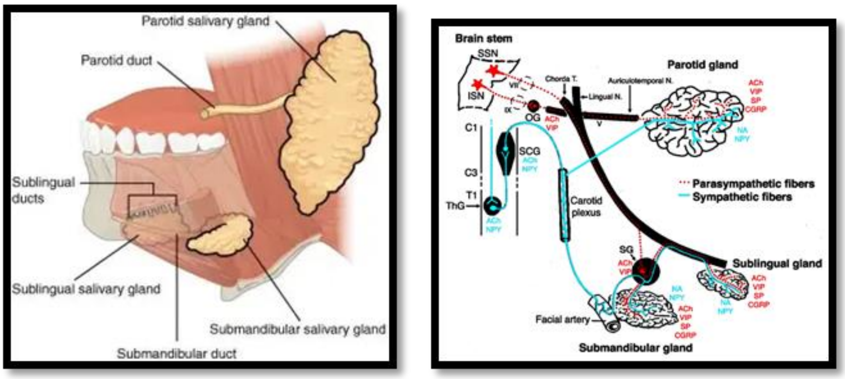
INTRODUCTION

Saliva, secreted by the major (parotid, submandibular, sublingual) and minor salivary glands, is a complex biological fluid with a composition that includes water, electrolytes, enzymes, proteins, mucins, and antimicrobial compounds. This composition gives saliva a multifunctional profile, making it indispensable for oral homeostasis. It supports digestion, aids in lubrication, buffers acids, protects oral tissues, and modulates the oral microbiome. These functions have direct implications for prosthodontic care, especially in patients requiring complete or partial dentures, implant-supported prostheses, or long-term oral rehabilitation.

Saliva's physical properties—such as viscosity, wettability, and volume—affect prosthesis retention, mucosal interface dynamics, microbial colonization, and patient comfort. Despite its crucial role, salivary assessment is often overlooked in prosthodontic planning. With xerostomia becoming increasingly common due to systemic illnesses, aging, polypharmacy, and head and neck radiation, it is essential to recognize the profound influence of salivary changes on prosthetic success.

Salivary Gland Embryology, Anatomy, and Histology

Salivary glands originate from epithelial invaginations in the embryonic oral cavity, with major glands developing around the 35th day of gestation and minor glands forming later. By the 7th–8th month, secretory acini differentiate into serous or mucous types. The parotid gland, the largest, lies over the masseter muscle and secretes serous fluid via Stensen's duct; it is closely associated with the facial nerve. The submandibular gland, beneath the mandible, secretes both serous and mucous saliva through Wharton's duct and lies near the facial artery and lingual nerve. The sublingual gland, the smallest, sits above the mylohyoid muscle and secretes mainly mucous via multiple small ducts (Fig. 1A). Minor salivary glands, distributed throughout the oral mucosa, produce mucous secretions that help maintain tissue moisture. Microscopically, salivary glands consist of mucous or serous acini connected to a ductal tree-like system with cuboidal epithelium, connective tissue, and a fibrous capsule. Serous cells produce enzymes like ptyalin for starch digestion, while mucous cells secrete mucin for lubrication and protection. Salivary gland innervation is autonomic: the parotid gland is innervated parasympathetically by the glossopharyngeal nerve (CN IX) via the otic ganglion, while the submandibular and sublingual glands receive parasympathetic fibers from the facial nerve (CN VII) via the chorda tympani and submandibular ganglion (Fig. 1B). Sympathetic fibers, originating from T1–T3 and synapsing in the superior cervical ganglion, modulate blood flow and secretion viscosity. Saliva is 99% water and 1% solutes, with a daily output of about 1.5 liters. It contains digestive enzymes (ptyalin, lipase), antimicrobial agents (lysozyme, IgA, lactoferrin), electrolytes (Na^+, K^+, Ca^{2+}, Cl^-, HCO_3^-), and organic substances like mucin, urea, and amino acids.



(A) **(B)**

Fig-1A: showing major salivary glands, 1B: nerve innervations of salivary glands.

Normal salivary flow exceeds 0.1 mL/min at rest and 0.2 mL/min when stimulated, influenced by factors like age, hydration, circadian rhythm, and systemic health. Flow is regulated by the medullary salivatory nuclei in response to taste, mechanical, and emotional stimuli. Reduced flow, or salivary hypofunction, can result from medications, aging, radiation therapy, or autoimmune diseases such as Sjögren's syndrome. Management involves stimulating saliva through taste or chewing and maintaining oral hygiene. Saliva serves essential functions: it aids digestion by breaking down starch and fats, lubricates tissues for speech and swallowing, enhances taste perception, buffers oral pH to prevent enamel erosion, protects against microbes, and helps excrete waste products.

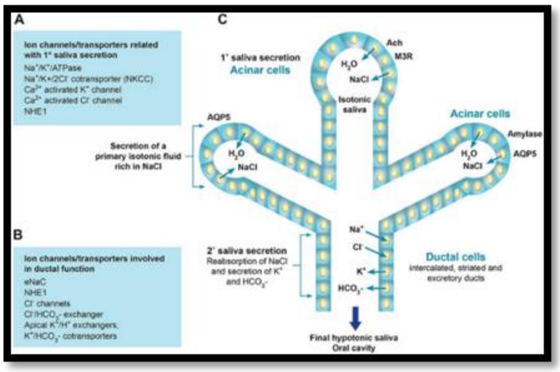


Fig-2: Mechanism of salivary secretion.

Salivary Secretions

It contains two main protein secretions: serous, rich in ptyalin (an α-amylase for starch digestion), and mucous, containing mucin for lubrication and protection. The parotid glands secrete only serous saliva, submandibular and sublingual glands produce both types, while buccal glands secrete mucus alone. Saliva typically has a pH between 6.0–7.0, optimal for enzymatic activity. Salivary secretion is controlled primarily by the autonomic nervous system. Parasympathetic stimulation via acetylcholine promotes copious, watery saliva, while sympathetic input (via superior cervical ganglia) results in thicker, protein-rich secretions. Salivatory nuclei, located at the junction of the medulla and pons, are activated by taste, tactile input, and higher brain centers. Stimuli such as sour tastes and smooth oral textures significantly increase flow, while stress may reduce it. Signals from the hypothalamus, especially during appetite or nausea, can also enhance salivation. Blood flow is essential—parasympathetic activity dilates vessels, and enzymes like kallikrein generate bradykinin, a potent vasodilator, enhancing glandular perfusion (Fig.2).

Saliva Formation

Saliva formation occurs in two stages: primary secretion from acini resembles extracellular fluid, rich in ptyalin and mucin; ductal modification then alters ionic content—sodium and chloride are reabsorbed, potassium is secreted, and bicarbonate is added. During low flow rates, saliva becomes hypotonic with elevated potassium and bicarbonate, while high flow rates (e.g., during chewing) reduce reabsorption time, increasing sodium and chloride levels. Aldosterone enhances sodium reabsorption and potassium secretion, further modifying ionic composition. Salivary regulation is influenced by medications and diseases. Adrenergic (sympathetic) and cholinergic (parasympathetic) drugs either stimulate or inhibit salivary output. For example, atropine reduces secretion (parasympatholytic), while pilocarpine increases it (parasympathomimetic).

The Ostlund hypothesis suggests mucin granules form near the nucleus, not merely by cytoplasmic pressure, indicating a nuclear role in secretion. Saliva impacts dental health through its inorganic and organic components. Calcium and phosphate can both promote calculus and protect enamel. Buffer systems, including carbonate and phosphate, maintain oral pH and prevent demineralization. Mucin, while protective, may also contribute to acid formation when degraded. Thick saliva may impair mechanical cleansing but helps buffer acids. Xerostomia (dry mouth) occurs due to reduced secretion, often caused by autoimmune diseases like Sjögren's syndrome, certain medications, or radiation therapy. Symptoms include dryness, difficulty swallowing, altered taste, and increased caries risk. Management includes hydration, salivary stimulants (sugar-free gum, pilocarpine), saliva substitutes, and rigorous oral hygiene. Regular dental visits and fluoride use are crucial for preventing complications.

Saliva in Denture Retention and Stability

Saliva plays a crucial role in the adhesion and cohesion mechanisms essential for denture retention. It acts as an intermediate layer between the mucosa and the denture base, forming a thin film that generates capillary and surface tension forces. This film ensures that the denture adheres to the mucosal tissues by creating suction and providing a seal.

In patients with normal salivary flow, serous saliva facilitates better wettability and adaptation of the denture base, leading to improved stability. Conversely, thick and ropey saliva may hinder the spreading of the salivary film and reduce adhesive effectiveness. In xerostomia, the lack of this film results in poor retention and dislodgement of the prosthesis during function. Supplementing with denture adhesives or transitioning to implant-supported overdentures can help address these challenges.[16-18]

Saliva and Mucosal Protection

Saliva protects the oral mucosa through its lubricative and antimicrobial properties. Mucins and glycoproteins form a viscoelastic protective coating that reduces frictional trauma from mastication and prosthetic movement. Additionally, saliva contains a suite of antimicrobial agents—such as lysozyme, lactoferrin, peroxidases, histatins, and immunoglobulin A (IgA)—which suppress pathogenic microorganisms and maintain oral microbial balance.[19,20]

In prosthodontic patients, particularly complete denture wearers, mucosal protection is vital to prevent trauma, ulceration, or denture stomatitis. In individuals with reduced salivary flow, the mucosa becomes dry, less resilient, and more prone to injury. This necessitates careful material selection, smooth denture borders, and possibly the use of soft liners or tissue conditioners for enhanced comfort.[21]

Saliva's Role in Taste and Speech

Taste and speech are two essential functions supported by saliva. Taste perception is facilitated by the solubilization of food molecules, allowing them to interact with taste receptors on the tongue. Saliva also maintains an optimal ionic environment required for signal transduction in gustatory cells. Salivary deficiency may result in hypogeusia (reduced taste) or dysgeusia (altered taste), often leading to decreased appetite and nutritional compromise.[22]

Speech, particularly articulation of sibilants and fricatives, depends on the lubricated movement of oral soft tissues and prostheses. Saliva enables smooth gliding of the tongue and lips, stabilizes the denture base during phonation, and prevents frictional irritation. Xerostomic patients often report difficulties in speaking clearly, increased salivary clicking sounds, and a need for frequent sips of water to articulate properly.[23,24]

Saliva and Maintenance of Prosthetic Hygiene

Saliva serves as a natural cleansing agent in the oral cavity. It neutralizes acids, flushes away food debris, dilutes sugars, and prevents the formation of dental biofilms. Saliva also regulates the growth of microbial communities on prostheses through immunological components such as IgA and lactoferrin.

Inadequate salivary flow facilitates the accumulation of plaque and debris on denture surfaces, leading to halitosis, candidiasis, and mucosal inflammation. This is particularly problematic in complete denture wearers who may not feel the initial signs of infection. To counteract this, patients with low salivary output must be educated on rigorous denture hygiene practices, including mechanical cleaning, use of antifungal mouthwashes, and possibly enzymatic cleansers for prostheses.[25.-27]

Prosthodontic Challenges in Xerostomia

Xerostomia poses multifaceted challenges for prosthodontists. The condition impairs the physical and biological functions of saliva, leading to poor denture retention, discomfort, compromised speech and taste, and increased susceptibility to infections. Common causes include autoimmune conditions like Sjögren's syndrome, anticholinergic medications, chemotherapy, and radiation therapy.

Management of xerostomia involves both systemic and local interventions. Pharmacologic agents such as pilocarpine and cevimeline may stimulate residual gland function, while non-pharmacologic measures like frequent water intake, sugar-free chewing gums, and humidifiers provide symptomatic relief. From a prosthodontic standpoint, lightweight prostheses with extended coverage and optimal surface polish are recommended. In severe cases, implant-supported overdentures provide superior function and retention.[28-30]

Saliva and Implant Prosthodontics

Implant success is closely linked to peri-implant mucosal health, which is significantly influenced by saliva. Saliva contributes to pellicle formation on implant abutments, modulates early microbial colonization, and helps maintain a neutral pH environment around implants.

Antimicrobial peptides in saliva, including defensins and cathelicidins, aid in preventing peri-implantitis.

In xerostomic patients, lack of salivary lubrication and buffering capacity may predispose to soft tissue inflammation, mucosal desquamation, and biofilm buildup around implants. This necessitates individualized prosthesis design that permits thorough cleansing and access to peri-implant tissues. Regular maintenance visits, use of antimicrobial agents, and meticulous oral hygiene are essential components of implant aftercare in this population.[31-33]

Saliva and Material Selection in Prosthodontics

Material choice in prosthodontics must consider the interaction between prosthetic surfaces and saliva. Saliva affects surface wettability, microbial adhesion, chemical degradation and esthetic stability. Materials with low surface energy and hydrophobicity tend to accumulate plaque more readily. Hydrophilic materials, on the other hand, promote better interaction with saliva, enhancing comfort and function.

Metallic restorations, particularly those with chromium and nickel, may corrode under acidic or xerostomic conditions, releasing ions that can cause cytotoxic effects or allergic reactions. Ceramics and highly cross-linked acrylic resins offer greater chemical stability and biocompatibility in such environments. Additionally, bonding protocols must ensure that moisture contamination by saliva does not compromise adhesive interfaces.[34-36]

Clinical implication

When assessing patients prosthodontically, it's crucial to evaluate salivary flow and composition to inform material selection, prosthesis design, and personalized hygiene instructions. Patients with compromised salivary function require special consideration, particularly geriatric and medically compromised individuals who may experience xerostomia. Educating these patients on effective xerostomia management strategies is vital, and implementing preventive and supportive care protocols can significantly enhance their oral health outcomes and overall well-being.

Advancements in management of salivary dysfunction

Advancements in managing salivary gland dysfunction in prosthodontics have significantly improved care for xerostomic patients. New diagnostic tools, including salivary biomarkers and digital sialometry, allow early detection and tailored treatment. Hydrophilic denture base materials, soft liners, and saliva-retentive designs enhance comfort and retention in dry mouths. Digital workflows and CAD/CAM technology enable precise denture fabrication with optimized fit and surface texture. Therapeutic aids like pilocarpine gels, saliva substitutes, and mucoadhesive agents improve lubrication and mucosal protection. Implant-supported prostheses offer superior stability without relying on saliva. Emerging research in stem cell therapy and artificial glands holds promise for long-term solutions, making prosthodontic rehabilitation more effective and patient-centered.

CONCLUSION

Saliva is an essential but frequently underestimated component of successful prosthodontic treatment. Its roles extend beyond lubrication to encompass retention, protection, antimicrobial defense, and tissue resilience. Xerostomia, whether due to age, medications, or systemic illness, significantly affects prosthesis function and patient satisfaction. Comprehensive salivary assessment should be an integral part of prosthodontic diagnosis and treatment planning. Tailoring prostheses and materials to accommodate salivary variations ensures better clinical outcomes and long-term success.

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