Role of *Candida albicans* in Denture Stomatitis

1Chetan Hoshing, 2Santosh Dixit, 3Ajay Mootha, 4Nikhil Diwan

1Professor and Head, Department of Prosthodontics, School of Dental Sciences KIMSDU, Karad, Maharashtra, India
2Reader, Department of Prosthodontics, PDU Dental College, Solapur, Maharashtra, India
3Reader, Department of Prosthodontics, MA Rangoonwala Dental College, Pune, Maharashtra, India
4Senior Lecturer, Department of Oral Medicine and Radiology, Dr DY Patil Dental College, Pune, Maharashtra, India

Correspondence: Chetan Hoshing, Professor and Head, Department of Prosthodontics, School of Dental Sciences KIMSDU F-3 Sanjeevan Apartments, Opp Krishna Hospital, Karad, Maharashtra, India, e-mail: chetanhoshing@gmail.com

ABSTRACT

Despite therapeutic progress, opportunistic oral fungal infectious diseases have increased in prevalence, especially in denture wearers. The combination of entrapment of yeast cells in irregularities in denture-base and denture-relining materials, poor oral hygiene and several systemic factors are the most probable cause for the onset of this infectious disease. Hence, colonization and growth on prostheses by *Candida* species are of clinical importance. *Candida albicans* is a dimorphic yeast strongly Gram-positive able to live as normal commensal organism in the oral cavity of healthy people. It is the yeast more frequently isolated in the oral cavity. Under local and systemic factors related to the host conditions, it becomes virulent and responsible of oral diseases known as oral candidiasis. The purpose of this review is to critically discuss several key factors controlling the adhesion of *Candida* species which are relevant to denture-associated stomatitis.

Keywords: *Candida albicans*, Denture stomatitis, Antifungal drugs, Denture, Saliva.

INTRODUCTION

*Candida albicans* is an innocuous commensal of the microbial communities of the human oral cavity. Its primary location is the posterior tongue and other oral sites as the mucosa, while the film that covers the dental surfaces is colonized secondarily. Numerous studies have shown that several *Candida* species possess a multitude of virulence mechanisms leading to successful colonization and infection of the host when suitable conditions occur.1 Frequently, when the host defense system suffers because of any alterations, like immunodeficiency, *Candida albicans* become virulent and generates candidiasis, that can be manifested through various clinical forms, involving one or more oral sites, up to affect the whole oral cavity and to disseminate into invasive forms. *Candida*-associated denture stomatitis is a very common inflammatory process affecting about 60% of the subjects carrier of a prosthesis.2

ROLE OF SURFACE PROPERTIES ON CANDIDA COLONIZATION

Fungi normally live as innocuous commensals and colonize various habitats in humans, notably skin and mucosa. Commensal existence of oral *Candida* species varies from 20 to 50% in a healthy dentulous population. As growth on surfaces is a natural part of the *Candida* lifestyle, one can expect that *Candida* colonizes denture. There is a large body of evidence indicating that *Candida* is able to adhere to acrylic resin dentures. This is the first step that may lead to the development of the infectious process and that may ultimately result in varying degrees of denture stomatitis of the adjacent mucosa. *Candida* adheres directly or via a layer of denture plaque to denture base (polymethylmethacrylate).3 It is well-known that innumerable factors are involved in the adhesion of *Candida* to the acrylic resin base, though contradictory results have been reported from *in vitro* studies. Substrate surface properties, as surface charge, surface-free energy, hydrophobicity, and roughness have all been reported to influence the initial adhesion of microorganisms. Microbial adhesion on biomaterial surfaces depends on the surface structure and composition of biomaterials, and on the physicochemical properties of the microbial cell surface, again its surface charge and hydrophobicity. Components of the resilient denture liners and acrylic resin may reduce the adhesion and inhibit the growth of *Candida*.4

PATHOGENESIS

The pathogenesis of the *Candida*-associated denture stomatitis is elaborate and multifactorial. It includes local and systemic factors related to the host and to the *Candida* capability to adhere and proliferate in the host epithelial tissues. *Candida*-associated denture stomatitis is able to rise up when the conditions of the microoral environment are favorable for the growth and the adhesion of the yeast and also when systemic factors of the host bring to a depression of the mechanisms of defence.5

SYSTEMIC FACTORS

Diabetes

The saliva of diabetics favors the growth of *Candida albicans in vitro* and it has been shown that on the denture surfaces of diabetic there are more elevated counts of colonies of the yeast by comparison with the nondiabetic subjects.6
**Deficiency of Nutritional Factors**

Some authors report the sideropenic anemia and high levels of cholesterol as causes of candidiasis.

**Xerostomia**

Qualitative and quantitative alterations of the salivary flow in elderly patients is probably secondary to the assumption of drugs, above all the antihypertensive ones, rather than a primary functional deficit. Such reduction has been shown to act as predisposing factor to the virulence of the *Candida* species.\(^7\)

**LOCAL FACTORS**

**Traumas**

Traumas are considered as the main liable to determine *Candida*-associated denture stomatitis with none association with the microbial communities and the presence of denture.\(^3\)

**Role of Salivary Properties on Candida**

The role of human saliva in the *Candida* adhesion process is still controversial. Saliva shows a physical cleaning effect and innate defence molecules, including lysozyme, histatin, lactoferrin, calprotectine and IgA. Other components in whole saliva, including mucins, statherin and proline-rich-proteins have been reported to adsorb to *Candida albicans*, thereby facilitating adherence to saliva coated acrylic resins.\(^8\)

**pH of the Oral Cavity**

Low levels of pH can favor the adhesion and the proliferation of *Candida* yeast. In fact, a pH equal to 3 is optimal not only for the adhesion of the yeasts, but also for the enzymatic activity of the proteinases that together with the lipases, are the most important factors of virulence of permeability of the acrylic resins. In presence of poor oral hygiene, *Candida* can penetrate, stick and aggregate with the bacterial communities, as *Streptococcus sanguis*, *Streptococcus gordonii*, *Streptococcus oralis* and *Streptococcus anginosus* by the interactions between proteins and carbohydrates.\(^9\)

**PRESENCE OF MICROBIAL PLAQUE**

Various microbiologic studies underlined that the plaque accumulated on the dentures during stomatitis has a complex composition, represented above all by Gram-positive bacteria, as *Streptococcus sanguis*, *S gordonii*, *S oralis*, *S anginosus*, *Staphylococci* and rods as Actinomycetes predominantly, followed by *Lactobacillus*. The microorganisms present in the oral cavity interact between them in various ways, as using directly their own metabolic products or exchanging themselves molecular signals. Several studies have shown that the coaggregation includes protein-carbohydrates interactions.\(^10,11\) *Candida* has been shown to be the predominant pathogen. First of all, it has been seen that patients with denture stomatitis show an increase in the presence of *Candida* when compared to the controls. Second, the patients response to the antimycotic therapy with a drastic decrease of the colonies present in the denture plaque. As third point, we must recall that the mass of yeast cell is 50 times greater than that of a coccus and that the mass of an hypha can be greater hundreds of times than that one of a rod. *Candida*, therefore, plays a key pathogenetic role in the onset of the denture stomatitis, even if the cooperative role practiced by the bacterial plaque present on the denture must not be neglected.\(^12,13\)

**ADHESION**

The ability of *Candida* to pass through the tissues is the first step of the infectious process. It has been observed that the forms endowed with hyphae are able to stick and to invade more quickly the tissues of the host.\(^14\)

**THERAPY**

The treatment of *Candida*-associated denture stomatitis is complex because of its multifactorial etiology. The therapeutic strategy still adopted includes the use of topical and systemic antifungal drugs, the use of preservatives and disinfectants, the irradiation with microwaves and the scrupulous removal and control of the plaque present on the denture and on the oral mucosa.\(^15\)

**ANTIFUNGAL DRUGS**

The antifungal treatments more used are antifungal suspensions based on nystatin, amphotericin-B, miconazole and fluconazole. Almost all drugs generally produce a complete remission of symptoms within 12 to 14 days. Webb says that Epstein et al showed the importance of antifungal therapy in the treatment and prevention of oral candidiasis. They noticed that nystatin and amphotericin-B, because of their binding to the ergosterol on the *Candida* cellular membranes, causes changes in the permeability of the cell membrane, leading to their penetration into the cells and causing finally the cell death. Toubic et al bring that Merkel and Phelps showed that sublethal doses of amphotericin-B inhibit the adhesion of *Candida* to the cultures of mammalian cells, and that the blastospores in the stage of active growth are more sensitive to the drug. Other studies have shown that subinhibiting doses of nystatin, amphotericin-B and miconazole inhibit adhesion of *Candida* to epithelial cells. Among the topically antifungal drugs used, the efficacy of ‘locetar’ was noted, it is used in the treatment of onychomycosis. Amorolfine belongs to a new class of chemical antifungal. Its fungistatic and fungicide effect is based on the alteration of the fungal cell membranes, in particular at the level of the sterols biosynthesis. In this way, the content of ergosterol is reduced, and at the same time not usual planar sterols accumulate. Amorolfine possesses a broad spectrum of action *in vitro*, and it is particularly effective versus dirofilariosis (trichophytos, microsporum, epidermophyton), yeasts (*Candida*), molds (Alternaria, Hendersonula); with the exception of actinomycetes, the bacteria are not sensitive to amorolfine.\(^2,12\)

**PRESERVATIVE AND DISINFECTANT AGENTS**

The use of antiseptic substances as the 0.2% chlorhexidine gluconate administrated 3 or 4 times a day, is capable of carrying on a significant reduction of the plaque but it has not a significant...
effect on the reduction of the colonies of Candida. More encouraging results are obtained when the dentures are immersing into 2% chlorhexidine as aid to topical therapy. Note that the chlorhexidine never must be administered at the same time with the nystatin since it inhibits the antifungal capacity. Another antiseptic substance used is sodium hypochlorite. It is proven that by diving the denture in a solution of 0.02% sodium hypochlorite, the number of Candida and bacteria amount on the denture surface effectively decrease. Unfortunately, sodium hypochlorite may not be used for an indeterminate period of time according to its ability to damage the prosthesis.4

MICROWAVE IRRADIATION

Irradiation with microwave has been proposed as a quick effective and cheap method for the denture disinfection. In vitro the exposure to the microwaves was able to cause the cell death of Candida albicans. Clinical assessment has proved the real effectiveness of this methodology to disinfect the denture and to treat Candida-associated denture stomatitis by the exposure of the denture to the microwaves (350 Watt, 2450 MHz) for 6 minutes, removing the presence of Candida and bacteria. However, this treatment is responsible to produce conformational changes on the denture, according to the duration of the treatment and therefore on the possibility of adopting this method together with maneuvers of oral and denture hygiene. In fact, according to the quantum theory, the waves formation induces a production of energy that could interfere with the dimensional stability of the denture.4

SCRUPULOUS REMOVAL OF DENTURE PLAQUE

The poor oral and denture hygiene are fundamental in the onset of disease, demonstrating the importance of the cleanliness of the denture through mechanical and chemical methods. An efficient control of the microbial plaque on the dentures remains the most important and certain procedure to follow. A good oral hygiene can be alone effective in treating denture stomatitis as well as when it is adopted in association with systemic and topical antifungal drugs. The hygiene control of denture is also essential to avoid relapses of pathology following treatment with antifungal drugs and, therefore, it is an important measure for the prophylaxis of candidiasis. Both the prosthesis that oral mucosa in contact with it must be involved in procedures for oral hygiene through brushing them after each meal with water or chemical agents.16 The patients should also be instructed to remove the denture during night and to leave it dry; in addiction, during therapy for stomatitis, the prosthesis should be removed for at least two weeks.9,15

CONCLUSION

Denture stomatitis has been reported in 11 to 67% of complete denture wearers. It is more common on the palatal mucosa and in female patients. In Newton’s type I denture stomatitis, where the inflammation remains focal, trauma seems to be responsible. In Newton’s types II and III denture stomatitis, where the denture-bearing mucosa is diffusely involved, most workers assert that the etiology is multifactorial. Evidence is presented incriminating Candida albicans colonization of the fitting surface of the prosthesis in many cases of denture stomatitis promoted by continuous denture wearing. Allergic and primary irritant reactions to the denture base material, systemic predisposing factors including dietary deficiency and hematological disorders, also play a part. In most cases of denture stomatitis, elimination of denture faults, control of denture plaque and discontinuous denture wearing are sufficient treatment. The routine use of antiseptic or antimycotic drugs seems unnecessary.

REFERENCES
