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Review Article

Awareness of the Evolution and Complications of Candida-Associated Denture Stomatitis

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Abstract

Candida-associated denture stomatitis (CADS) is a prevalent yet frequently overlooked chronic infectious-inflammatory condition affecting denture wearers, particularly the elderly and immunocompromised individuals. While often asymptomatic in its early stages, CADS progressively alters oral mucosal integrity, disrupts prosthetic function, and may act as a reservoir for systemic fungal dissemination.

Objectives: This review critically examines the multifaceted complications of CADS, emphasizing its impact on oral soft tissues, prosthetic stability, and implant survival. The interplay between fungal biofilms and host immune responses is explored, highlighting the progression from localized mucosal infection to broader systemic consequences. Furthermore, the review discusses the potential role of CADS in exacerbating conditions such as aspiration pneumonia, endocarditis, oropharyngeal candidiasis, drawing attention to its underestimated clinical significance.

Conclusion: Far from being a mere localized oral pathology, CADS represents a complex interplay between prosthetic factors, host immunity, and microbial virulence, with implications that extend beyond the oral cavity.

Keywords: *Candida albicans;* Denture Stomatitis; Candidiasis; Oral Biofilm; Denture; Peri-Implantitis; Oral Health; Oral Mucosa; Elderly

Introduction

Candida-associated denture stomatitis (CADS), also known as chronic atrophic candidiasis, is a common multifactorial, chronic inflammatory condition that primarily affects denture wearers, whether conventional or implant-supported, most commonly attributed to *Candida* spp [1]. While dentures restore essential functions lost due to edentulism—such as mastication, phonation, and aesthetics—they can also negatively impact the underlying oral mucosa. This condition, which involves the oral mucosa in contact with the denture base, most frequently affects the palate [2] and is more commonly observed in patients wearing acrylic dentures as compared to other types of prostheses. CADS is particularly prevalent among elderly individuals, as this age group is more likely to use removable dentures, including complete or partial dentures, intraoral removable orthodontic appliances, and obturators [3]. However, while it is most commonly associated with older populations [4], CADS can also occur in younger, otherwise healthy individuals who wear dentures.

However, the geriatric population, often presenting with complex medical histories, systemic conditions, long-term medication use, and compromised immune systems, is at greater risk for developing CADS. These factors can weaken the oral mucosa's defense mechanisms, increasing susceptibility to infection and influencing how dentures interact with the underlying oral tissues. Additionally, due to the asymptomatic nature of CADS in its early stages [5], the condition often progresses unnoticed, making early detection and timely intervention critical for preserving oral health.

Given the intricate nature of CADS and its potential complications, it is imperative for clinicians to possess a comprehensive understanding of its progression, prognosis, and associated risks. A systematic, evidence-based approach to diagnosis, monitoring, and management is vital to prevent long-term consequences. These complications, as depicted in Figure 1, are thoroughly explored and discussed in detail in our narrative review.

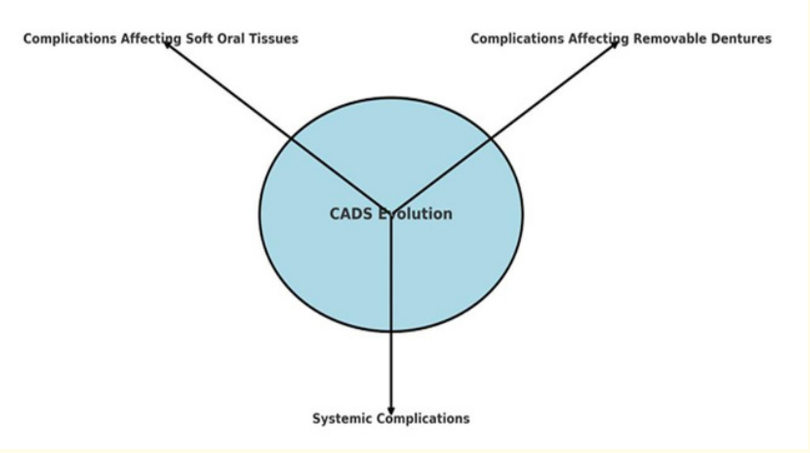

Figure 1: Complications Associated with Candida-Associated Denture Stomatitis (CADS).

Complications affecting soft oral tissues

The alteration of the normal histological structure of the palatal mucosa constitutes a primary, often irreversible, long-term effect of CADS. Microscopic pathological examination reveals thinning of the corneal layer of the epithelium, the potential absence of keratinization, generalized epithelial atrophy or hyperplasia, along with a massive intraepithelial leukocytic inflammatory infiltrate [6]. These histopathological changes directly compromise the natural barrier function of the oral mucosa, increasing its susceptibility to penetration by other microbial antigens, and also impact the tolerability of dentures.

Although the literature on the multifactorial etiology of non-idiopathic Burning Mouth Syndrome (BMS) is inconsistent, some studies suggest that patients with CADS may be at increased risk for developing BMS. This is particularly relevant since a higher proportion of patients with BMS are denture wearers [7,8]. However, the progression of CADS to BMS remains controversial, with studies highlighting that no fungal agents were found in patients presenting with oral burning sensations and showing normal oral mucosa, which contrasts with the clinical presentation typical of CADS [8].

Angular cheilitis is frequently associated with CADS (Figure 2), with the infection often starting in the vicinity of the maxillary denture base and spreading to the commissures.

Local predisposing factors, such as ill-fitting dentures or the absence of the buccal corridor, lead to the accumulation of infected salivary secretion around the denture margins, facilitating its spread to the canines. Additionally, dry facial tissues (often seen in conjunction with xerostomia and CADS contribute to the formation of fissures at the commissures, further facilitating microbial invasion [9]. According to Greenberg., *et al*. (2008), 30% of patients with CADS also present with angular cheilitis, whereas only 10% of denture wearers without CADS exhibit commissural involvement [10].

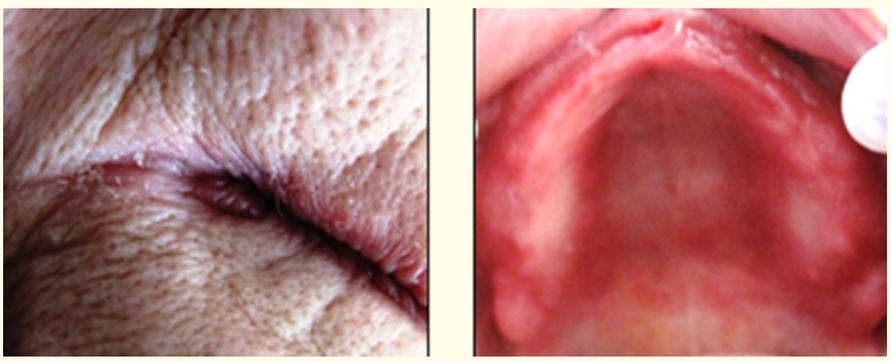

Figure 2: Angular cheilitis associated with CADS.

Another notable soft tissue complication of CADS is median rhomboid glossitis (MRG), which is a fungal-related lesion typically located on the dorsum of the tongue, around the midline. MRG appears as a well-demarcated, symmetric, depapillated area anterior to the circumvallate papillae, although it can sometimes manifest in a paramedial location [11]. The lesion's surface may be smooth or lobulated, and while many patients remain asymptomatic, some report persistent pain, irritation, or pruritus [12]. When MRG occurs alongside palatal inflammation, forming what is referred to as the 'kissing lesion' (Figure 3), the presence of systemic immunosuppression should be strongly considered. This association is particularly noted in immunocompromised elderly patients, especially in those with Acquired Immunodeficiency Syndrome (AIDS), which has been linked to the development of MRG and its correlation with CADS in these populations [13]. The recognition of such a lesion serves as an important marker for clinicians to assess and investigate potential underlying immune system weaknesses, especially in older denture wearers.

Figure 3: Smooth appearance of median rhomboid glossitis (MRG) associated to CADS.

Another local effect of CADS is the progression of generalized erythematous forms, classified by Newton [14] as type II denture stomatitis (DS), towards hyperplastic, papillomatous forms (type III) (Figure 4). This progression requires a different therapeutic approach, often necessitating surgical intervention. There are no studies to date providing an estimated timeline or identifying the specific factors that lead to the development of epithelial hypertrophy towards a hyperplastic pattern.

Figure 4: Hyperplastic, papillomatous CADS.

Thomas., *et al*. [15] suggested that inflammatory papillary hyperplasia in denture wearers may not necessarily result from the progression of earlier stages of prosthetic stomatitis, but rather could be a genetic predisposition in certain individuals or part of a combination syndrome. Furthermore, some studies propose that all three clinical forms of this condition may coexist on the same denture-bearing surface [16].

The malignant transformation of hyperplastic lesions in DS represents another extensively debated evolutionary pattern. However, it is important to note that no clinical studies to date have confirmed the malignant potential of these lesions, and the prognosis of CADS is generally considered favourable when appropriate treatment is applied [17]. Nevertheless, the fungal agent responsible for the disease, through an insufficiently explained mechanism, has been significantly correlated with varying degrees of epithelial dysplasia [18]. Therefore, lesions that do not respond to treatment should be carefully analysed. In this context, it is important to mention the recognized oncogenic potential of *Candida albicans*, as postulated by Krogh., *et al*. who demonstrated that fungi of the *Candida* genus produce carcinogenic nitrosamines [19]. Patients with persistent erythematous lesions in the denture-bearing mucosa lasting longer than two weeks, despite treatment and evaluation of the removable prosthesis, especially when combined with other risk factors such as tobacco and alcohol consumption, should be referred for specialized investigations.

Complications affecting removable dentures

Untreated CADS can sometimes induce painful local symptoms and ridge resorption [20], leading to difficulties in mastication, which subsequently have repercussions on nutritional status. Papillary hyperplasia, as a final evolutionary form of denture stomatitis, can cause secondary instability of dentures due to changes in the mucosal support substrate [21]. Alterations in the prosthetic balance of correctly fabricated dentures may also occur in the congestive, erythematous, generalized form of denture stomatitis, due to the hypertrophied volume, edema of the mucosal support, and loss of adaptation to the prosthetic field.

Candida albicans is the species most frequently isolated in peri-implantitis, where it develops thick biofilms over the peri-implant surface [22]. Given its ability to adhere to the implant area in intimate contact with the bone, it has been hypothesized that *Candida* could contribute to the progression of peri-implant diseases. In the case of implant-supported dentures, untreated or even undiagnosed prosthetic stomatitis may become an active septic focus,

potentially compromising osseointegration. The fungal agent from the *Candida* genus has been reported in many cases of peri-implantitis and implant loss in both completely (Figure 5) and partially edentulous patients, alongside other microorganisms [20,23].

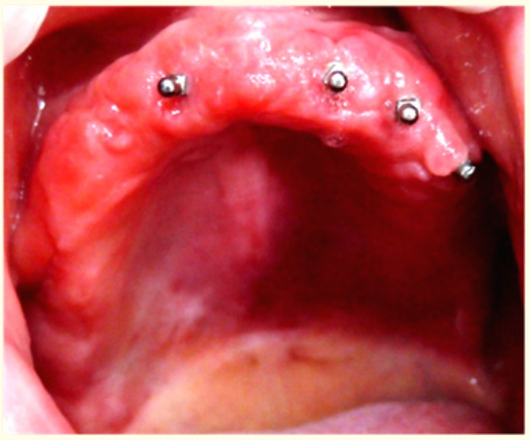

Figure 5: CADS in a compromised mini implant-supported maxillary overdenture due to fungal peri-implantitis.

For this reason, there is a general consensus that, prior to implant placement, complete decontamination of both the oral cavity and the dentures is necessary for patients with removable dentures [24]. This is particularly important because the source of reinfection and recurrence of CADS is represented by the acrylic denture base [25].

Systemic complications

Untreated CADS may persist for months or even years in most patients until the underlying determinant and/or predisposing factors are eliminated. Elderly patients, who are often wearers of removable dentures, are significantly more frequently affected by associated fungal infections compared to other age groups, and this is often accompanied by considerable morbidity and mortality rates. Diagnosing these infections can be particularly challenging due to the different symptomatology in older populations compared to other age groups [26]. Given that denture wear is a high-risk factor for oral fungal colonization in the elderly [27], Malani et al. [28] reported a threefold higher risk of colonization with *Candida glabrata* in denture wearers compared to non-denture wearers. However, they also noted that this oral colonization does not preferentially lead to systemic dissemination or invasion of the circulatory system.

As before mentioned, there exists a frail subgroup within the elderly popultaion with compromised immunity and significant comorbidities, for whom a mutual interdependence between oral *Candida* infections and pharyngeal infections with the same pathogen has been reported [29]. For such patients, the presence of manifest oropharyngeal candidiasis should be considered a primary indicator of systemic conditions.

In certain clinical scenarios, CADS may serve as a prognostic indicator for the risk of other diseases, with subepithelial invasion of oral tissues being one such marker [30]. The exacerbation of oral fungal infections in denture wearers may lead not only to local discomfort but also to alterations in taste and dysphagia, especially when esophageal mucosa is involved. In immunocompromised patients, extreme cases may result in fungal dissemination to the circulatory system and upper gastrointestinal tract, leading to severe infections with notable morbidity and mortality [31]. Furthermore, studies have confirmed the colonization of the lower gastrointestinal tract with Candida species in patients with DS, regardless of their immune system status [32].

The literature has also reported a significant correlation between CADS and aspiration pneumonia in geriatric patients with poor local hygiene (both oral and denture hygiene). The aspiration mechanism is due to swallowing disorders often observed in the elderly, as well as reduced mucociliary clearance of the airways in these patients. Normally, oral pathogens that reach the bronchopulmonary tree are phagocytosed by alveolar macrophages, a process that sometimes fails in elderly individuals with immune depression [33].

Finally, it is important to highlight the risk of preliminary fungal contamination of the fingers in patients with denture stomatitis during the removal of dentures from the oral cavity. The frequent discovery of finger infections with various species of *Candida* originating from the oral cavity plays a prophylactic role, as patients with CADS should be informed about this and instructed on the im-

portance of personal hygiene, in addition to optimizing denture hygiene [34]. Among all *Candida* spp, *Candida albicans* is the only one with a dual behavior, both commensal and opportunistic. Although it survives poorly on dry surfaces (which supports the recommendation of keeping dentures dry overnight), it can remain viable for extended periods on wet surfaces. For instance, *Candida* has been isolated from the toothbrushes of patients in a carrier state and can survive in creams and other cosmetic products, as well as on clothing. An increased rate of colonization has also been reported on human epidermis, particularly in areas with moisture, such as skin folds [35].

Conclusions

CADS is a prevalent yet often underestimated oral condition with significant implications for both local and systemic health, particularly in elderly and immunocompromised individuals. While the presence of dentures serves a crucial role in restoring oral function, it also creates a favorable environment for fungal colonization, leading to chronic mucosal inflammation of the denture bearing soft tissue, which may extend to broader oral health concerns, Beyond its impact on soft tissues, CADS also affects prosthetic function and stability. Moreover, fungal biofilms have been implicated in peri-implant diseases, raising concerns about their potential role in peri-implantitis and implant failure.

The systemic implications of CADS further emphasize its clinical significance. Denture wearers, especially elderly individuals with comorbidities, exhibit a heightened risk of aspiration pneumonia due to fungal colonization of the oropharynx, combined with impaired swallowing and reduced mucociliary clearance. Additionally, association of CADS and lower gastrointestinal tract colonization by Candida spp, independent of immune status, raises concerns about its potential contribution to systemic fungal infections.

Early detection, appropriate treatment, and preventive strategies in CADS are therefore paramount. Interdisciplinary collaboration between dentists, geriatricians, and other healthcare providers is essential for the comprehensive management of patients, particularly those with systemic vulnerabilities. Further research is needed to clarify the precise mechanisms underlying CADS progression and its systemic interactions, as well as to develop more effective long-term management strategies. By adopting a proactive, evidence-based approach to diagnosis and management, clinicians can improve patient outcomes and prevent the progression of CADS-related complications.

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