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DENTURE STOMATITIS: AN OVERVIEW OF EPIDEMIOLOGY, ETIOLOGY, AND CURRENT THERAPEUTIC STRATEGIES

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ABSTRACT
Denture stomatitis (DS) is a prevalent inflammatory condition of the oral mucosa, frequently observed in individuals wearing removable dentures. The condition is primarily initiated by the colonization of *Candida* species, though its development is often accelerated by other predisposing factors, making it a multifactorial clinical challenge. This article provides a comprehensive overview of the condition by focusing on a systematic review of the most recent scientific literature published from 2020 onward. The research methodology involved a systematic search across multiple scientific databases to gather current data on the epidemiology, etiology, risk factors, and contemporary therapeutic approaches for DS. The results from this review indicate a high prevalence of the condition, with a notable incidence among elderly patients and individuals with specific systemic health issues. The findings confirm that effective management necessitates a multifaceted strategy, combining conventional antifungal agents, innovative approaches like photodynamic therapy, and strict adherence to enhanced denture hygiene protocols. In conclusion, the successful treatment of denture stomatitis is not a one-size-fits-all solution; it requires an individualized therapeutic plan that is carefully tailored to each patient's specific risk factors and the underlying etiology of their condition.
Keywords: *denture stomatitis; Candida albicans; antifungal therapy; photodynamic therapy; denture hygiene*

ABSTRAK
Stomatitis gigi tiruan (DS) merupakan kondisi peradangan yang umum terjadi pada mukosa mulut, yang sering terjadi pada orang yang memakai gigi tiruan lepasan. Kondisi ini terutama dipicu oleh kolonisasi spesies Candida, meskipun perkembangannya sering kali dipercepat oleh faktor predisposisi lain, sehingga menjadikannya tantangan klinis multifaktorial. Artikel ini memberikan gambaran umum yang komprehensif tentang kondisi tersebut dengan berfokus pada tinjauan sistematis literatur ilmiah terbaru yang diterbitkan sejak tahun 2020 dan seterusnya. Metodologi penelitian melibatkan pencarian sistematis di berbagai basis data ilmiah untuk mengumpulkan data terkini tentang epidemiologi, etiologi, faktor risiko, dan pendekatan terapi kontemporer untuk DS. Hasil dari tinjauan ini menunjukkan prevalensi kondisi yang tinggi, dengan insidensi yang menonjol di antara pasien lanjut usia dan individu dengan masalah kesehatan sistemik tertentu. Temuan tersebut menegaskan bahwa manajemen yang efektif memerlukan strategi multifaset, yang menggabungkan agen antijamur konvensional, pendekatan inovatif seperti terapi fotodinamik, dan kepatuhan ketat terhadap protokol kebersihan gigi tiruan yang ditingkatkan. Sebagai kesimpulan, pengobatan stomatitis gigi tiruan yang berhasil bukanlah solusi yang cocok untuk semua orang; Hal ini memerlukan rencana terapi individual yang disesuaikan dengan faktor risiko spesifik setiap pasien dan etiologi yang mendasari kondisi mereka.

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Kata kunci: *stomatitis gigi tiruan; Candida albicans; terapi antijamur; terapi fotodinamik; kebersihan gigi tiruan*

INTRODUCTION

Denture stomatitis (DS) is a pathological condition characterized by chronic inflammation of the oral mucosa, specifically in the area in direct contact with the base of a removable denture. This condition is one of the most common complications experienced by denture wearers, with an estimated prevalence ranging from 35% to 50% of all complete denture users, especially in the elderly population (Oktaria, 2022). Clinically, DS can manifest as widespread redness (*diffuse erythema*), swelling (*edema*), and in some cases, tissue overgrowth (*papillary hyperplasia*). These symptoms are often accompanied by a mild burning sensation on the palate, which can reduce the comfort and quality of life of patients.

The etiology of *denture stomatitis* is *multifactorial*, involving a complex interaction between mechanical, microbiological, and systemic factors. Mechanically, ill-fitting dentures, excessive pressure during chewing, and the habit of continuously wearing dentures without removal can cause chronic irritation to the mucosa and trigger an inflammatory response. The microbiological factor plays a key role, where poor oral and denture hygiene facilitates the colonization of pathogenic microorganisms. Notably, the fungus *Candida albicans* is known as the primary agent in the pathogenesis of DS due to its ability to form a strong *biofilm* on the acrylic surface of dentures, creating a conducive environment for persistent infection (Nasliah & Machmud, 2023).

In addition to local factors, the patient's systemic condition also contributes significantly to the development and severity of *denture stomatitis*. Patients with systemic diseases like *diabetes mellitus* or *immunocompromised* individuals have a much higher risk of developing DS. In these individuals, the oral mucosa becomes more susceptible to infection and exhibits a slower healing process, thereby exacerbating the existing inflammation (Ari et al., 2023). Lifestyle factors, such as smoking, can also worsen mucosal inflammation and disrupt local immune defenses, making DS management more complex and requiring a more holistic approach from clinicians.

To facilitate diagnosis and treatment planning, *denture stomatitis* is clinically classified according to Newton's classification system. This system divides DS into three main types based on its clinical appearance: Type I, characterized by *pinpoint hyperemia* or localized inflammation; Type II, which presents as *diffuse erythema* or widespread redness; and Type III, the most severe form, with the presence of *nodular papillary hyperplasia* (Oktaria, 2021). Each type shows a distinct clinical picture and often requires management strategies tailored to its severity. Conventional management generally focuses on improving denture hygiene and administering antifungal medications to control the *Candida* infection.

Figure 1. Denture stomatitis Type I (pinpoint hyperemia) of the palatal mucosa in contact with a denture (Ghiță et al., 2020).

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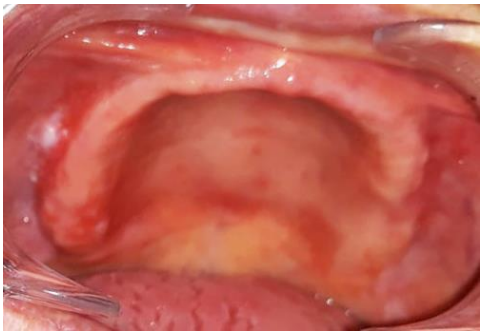

Figure 2. Denture stomatitis Type II (diffuse erythema) of the palatal mucosa in contact with a denture (Ghiță et al., 2020).

Figure 3. Denture stomatitis Type III (nodular papillary hyperplasia) on the anterior palatal mucosa supporting a denture (Ghiță et al., 2020).

Although conventional management with antifungal drugs is often the primary choice, this approach has several significant limitations. The ideal condition for patients is the availability of a therapy that is effective, safe for long-term use, easily accessible, and has minimal side effects. However, the reality is that synthetic antifungal drugs can cause side effects, and their continuous use can trigger the growing global concern of *microbial resistance*. Furthermore, the compliance rate of patients, especially the elderly, in adhering to strict denture hygiene protocols is often low. This gap between ideal therapy and existing limitations drives the urgent need to find safer and more sustainable treatment alternatives.

In response to this gap, research in the fields of pharmacy and dentistry is now exploring the potential of natural ingredients as a source of alternative therapy. Various herbal plants in Indonesia are known to possess bioactive compounds with potent antifungal, anti-inflammatory, and antioxidant properties. This research proposes an innovative solution by exploring the use of natural extracts, for example, ketapang leaf (*Terminalia catappa*) extract, which has been empirically used to treat infections. The main idea is to process this extract into a *topical* preparation, such as a *gel* or denture cleanser, that is easy to use, safe, and effective in inhibiting the growth of the *Candida albicans biofilm* and alleviating mucosal inflammation in DS patients.

The *novelty* of this research lies in the development and scientific validation of a herbal therapy product specifically formulated for the management of *denture stomatitis*. Its innovation is not only in the use of natural ingredients but also in the standardization of the extract, the formulation of a stable and patient-acceptable preparation, and testing its effectiveness both *in vitro* and clinically. The expected contribution of this research is to provide strong scientific evidence to support the use of herbal therapy as a credible alternative in dental practice. If proven effective, this product has the potential to become a safer, more

affordable treatment solution for DS, thereby improving the quality of life for millions of denture wearers in Indonesia.

RESEARCH METHODS

This study was conducted as a systematic literature review, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological transparency and rigor. A comprehensive and systematic search for relevant literature was performed across four major electronic databases: PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar. The search was limited to articles published between January 2020 and June 2025 to focus exclusively on the most current scientific evidence. The search strategy combined keywords and MeSH terms using Boolean operators (AND/OR), including: (*"denture stomatitis"* OR *"denture-related stomatitis"*) AND (*"Candida"* OR *"etiology"* OR *"risk factors"* OR *"treatment"* OR *"management"*). The search was restricted to publications written in the English language. Additionally, the reference lists of included articles were manually screened to identify any further relevant studies.

The study selection process was conducted in two distinct phases by two independent reviewers. After compiling the initial search results, duplicate entries were removed using reference management software. In the first phase, reviewers screened the titles and abstracts of all identified articles against predefined eligibility criteria. Articles were included if they were original research (clinical trials, observational studies), systematic reviews, or meta-analyses focused on the etiology or treatment of denture stomatitis in human subjects. In the second phase, the full texts of potentially eligible articles were thoroughly reviewed to confirm their suitability. Any disagreements between the two reviewers during the screening process were resolved through discussion and consensus, with a third reviewer available for arbitration if necessary to finalize the selection.

A standardized data extraction form was developed and utilized to collect pertinent information from each of the finally included studies. The extracted data comprised: author details, year of publication, study design, sample size, participant demographics, specific risk factors identified, therapeutic interventions investigated (e.g., antifungal agents, photodynamic therapy, probiotics), and the main outcomes reported. The methodological quality and risk of bias of each included study were critically appraised using appropriate tools, such as the Cochrane Risk of Bias tool for randomized trials. Due to the anticipated heterogeneity in study designs and outcome measures, a narrative synthesis approach was employed. The findings were thematically categorized and summarized to construct a comprehensive overview of the current evidence.

RESULT AND DISCUSSION

1. Definition and Epidemiology

Denture stomatitis (DS) is formally defined as a chronic inflammatory condition that affects the oral mucosal tissues directly underlying a removable dental prosthesis. Clinically, it presents with varying degrees of erythema, edema, and sometimes petechial hemorrhages on the palate and alveolar ridges, often following the exact outline of the denture base. While it can be asymptomatic, many individuals experience significant discomfort, including burning sensations, irritation, and pain, which can impair their quality of life by affecting eating, speaking, and overall comfort. The condition's chronicity and its direct link to denture use make it one of the most common pathologies observed in edentulous or partially edentulous populations, necessitating careful diagnosis and management by dental professionals to restore mucosal health and function(Ghiță et al., 2020; Papapanou et al., 2018; Saarela et al., 2021).

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The epidemiological prevalence of denture stomatitis exhibits a remarkably wide range, with studies reporting incidence rates from as low as 15% to as high as 70% among removable denture wearers. This significant variation is largely attributed to a confluence of influencing factors, including the demographic characteristics of the studied population, the type and duration of denture wear, and prevailing oral hygiene standards. As highlighted by researchers like da Silva et al. (2021), variables such as inconsistent denture cleaning, continuous overnight wear, and the material properties of the prosthesis itself play pivotal roles in determining an individual's susceptibility. Consequently, the broad prevalence underscores that DS is not an inevitability but rather a condition whose risk can be substantially mitigated through targeted preventive strategies and patient education(Featherstone et al., 2021; Wachter & Pikman, 2024).

Systemic health status emerges as a critical determinant in the prevalence and severity of denture stomatitis. Research by Vukosavljevic et al. (2023) specifically identifies a heightened prevalence among complete denture wearers who have concurrent systemic diseases, such as diabetes mellitus or conditions leading to immunosuppression. In diabetic patients, elevated glucose levels in saliva and crevicular fluid can create a favorable environment for *Candida* proliferation. Similarly, compromised immune function, whether due to diseases like HIV/AIDS or immunosuppressive therapies, impairs the host's ability to control fungal overgrowth on the oral mucosa. This evidence firmly establishes a link between systemic well-being and oral health, highlighting that these patient groups represent high-risk populations requiring more vigilant monitoring and proactive oral care interventions(Casamassimo et al., 2018; Haq, 2015; Kapila, 2021).

2. Etiology and Pathogenesis

The primary etiological factor driving denture stomatitis is the colonization and proliferation of the opportunistic fungus *Candida albicans* on the denture surface. While *C. albicans* exists as a commensal organism in the oral cavity of many healthy individuals, it undergoes a pathogenic transition under favorable conditions created by the denture microenvironment(Bao et al., 2023; Noble et al., 2016). It forms highly organized and resilient biofilms on the prosthesis, which are complex communities of yeast and hyphal cells encased in a protective extracellular matrix. This biofilm structure confers significant resistance to host immune defenses, salivary antimicrobial proteins, and conventional antifungal treatments. The initial, critical step in this process, as demonstrated by da Silva et al. (2021), is the strong adhesion of *Candida* cells to acrylic denture materials, establishing a persistent infectious reservoir.

The denture itself acts as a crucial fomite and incubator in the pathogenesis of denture stomatitis. The fitting surface of the prosthesis, typically made of polymethyl methacrylate (PMMA), possesses microscopic porosities and surface irregularities that provide ideal niches for microbial attachment and biofilm maturation. This protected environment shields the fungal colonies from the mechanical cleansing action of the tongue and saliva. Over time, this leads to the development of a mature, dense biofilm that continuously holds a high concentration of pathogenic microorganisms and their metabolic byproducts directly against the delicate palatal mucosa. This sustained contact often results in a subclinical infection that may persist for long periods before overt inflammatory symptoms become apparent, complicating early diagnosis and intervention(Arias et al., 2023; Dahlén et al., 2019; Min et al., 2023).

While *Candida* colonization is the principal cause, secondary factors significantly contribute to and exacerbate the inflammatory process. Mechanical trauma from ill-fitting or damaged dentures is a key contributor, as noted by Vila-Nova et al. (2021). Constant friction and excessive pressure can cause micro-abrasions and chronic irritation, compromising the

integrity of the mucosal epithelial barrier. This physical damage not only provides a direct portal of entry for fungal elements into the underlying tissues but also triggers a localized inflammatory response. Poor denture hygiene compounds this issue by allowing the biofilm to thicken, increasing the pathogenic load and inflammatory potential. This interplay between microbial factors and mechanical irritation creates a self-perpetuating cycle of tissue damage and inflammation characteristic of denture stomatitis.

3. Risk Factors

Local, denture-related issues are the most immediate and modifiable risk factors for denture stomatitis. Poor denture hygiene, as identified by Alrabiah et al. (2021), is paramount; failure to mechanically brush and chemically disinfect the prosthesis allows for the rapid accumulation of a thick, mature biofilm that serves as a constant reservoir for *Candida*. Compounding this is the practice of continuous denture wear, especially overnight. Vukosavljevic et al. (2023) explain that this prevents the mucosa from recovering and denies it the cleansing benefits of saliva, creating a warm, moist, anaerobic microenvironment ideal for fungal proliferation. Finally, ill-fitting or damaged dentures cause chronic mechanical trauma, leading to inflammation and creating epithelial breaches that facilitate microbial invasion, thereby completing a triad of local risks.

Systemic health conditions and their treatments profoundly influence a patient's susceptibility to denture stomatitis by altering the body's internal environment and immune capacity. Diseases like diabetes mellitus create a state of hyperglycemia, which can increase salivary glucose levels and provide a rich nutrient source for *Candida*. Furthermore, immunosuppressive states, resulting from conditions like HIV/AIDS or treatments such as chemotherapy and long-term corticosteroid use, directly impair the host's cellular and humoral immunity, allowing opportunistic oral flora to overgrow unchecked (Almeida et al., 2022). Additionally, nutritional deficiencies, particularly of iron and B vitamins, can compromise mucosal integrity and healing. Medications causing xerostomia, such as antihypertensives and antidepressants, reduce saliva's protective and cleansing functions, further promoting fungal colonization and increasing DS risk.

Patient-specific behavioral and age-related factors also play a critical role in the development of denture stomatitis. Lifestyle choices such as tobacco smoking and excessive alcohol consumption can directly irritate the oral mucosa, alter the oral microbiome, and impair local immune responses, making the tissue more vulnerable to infection. Poor nutritional habits can lead to the systemic deficiencies mentioned previously, further weakening mucosal defenses. Furthermore, advanced age often brings challenges such as diminished manual dexterity, which can make a thorough denture cleaning routine difficult to maintain. Age-related thinning of the oral mucosa also increases its fragility and susceptibility to mechanical trauma from the prosthesis. These factors often coexist, synergistically amplifying the overall risk profile for developing persistent and severe denture stomatitis(Ghiță et al., 2020; Osmari et al., 2016).

4. Treatment and Prevention

The foundational pillar of treating denture stomatitis is targeted antifungal therapy designed to eradicate the causative microbial biofilm. The choice of agent depends on the severity of the infection and patient factors. For mild to moderate cases, topical agents are preferred. Nystatin, a polyene antifungal, works by disrupting the fungal cell membrane and is often prescribed as an oral suspension or lozenge. Imidazole derivatives like miconazole and clotrimazole function by inhibiting ergosterol synthesis, a critical component of the fungal membrane. Miconazole is typically applied as a gel directly to the denture and mucosa, while clotrimazole is available as a palatable troche. In severe or refractory cases, systemic therapy

with fluconazole may be necessary, requiring careful consideration of potential drug interactions and hepatic function(Karri et al., 2018; Lalebeigi et al., 2024; Nazzaro & Veraldi, 2018).

Concurrent with pharmacological treatment, prosthesis modification and rigorous hygiene enhancement are non-negotiable for achieving long-term success. Any ill-fitting denture must be adjusted, relined, or remade to eliminate mechanical trauma and ensure an even distribution of occlusal forces. The fitting surface of the prosthesis should be polished to reduce surface roughness and minimize sites for biofilm accumulation. Most importantly, patients must be educated on a strict daily hygiene protocol. This involves mechanical cleaning with a soft brush and non-abrasive denture cleanser, followed by chemical disinfection using solutions like sodium hypochlorite or effervescent tablets. As stressed by Alrabiah et al. (2021), these steps are critical for removing the established biofilm and preventing its re-formation.

Ultimately, sustained prevention and patient empowerment form the third pillar of effective management. A crucial aspect of this is advising patients to remove their dentures overnight. This practice allows the underlying palatal mucosa to rest, recover from daily pressures, and benefit from the natural antimicrobial and cleansing properties of saliva, which significantly reduces microbial load and inflammation. Patient education must be reinforced during regular follow-up appointments, where clinicians can assess hygiene practices, inspect the prosthesis and tissues, and provide personalized feedback. This continuous cycle of professional oversight and patient self-care is essential for preventing the recurrence of denture stomatitis and maintaining long-term oral health, transforming the patient into an active partner in their own care.

5. Recent Advances

Recent research has increasingly focused on exploring natural products as adjunctive therapies for managing denture stomatitis, offering potentially safer and synergistic alternatives to conventional antifungal agents. As noted by da Silva et al. (2021), substances like propolis, a resinous mixture produced by honeybees, have demonstrated potent antimicrobial and anti-inflammatory properties. Its flavonoid and phenolic acid content can inhibit *Candida* growth and disrupt biofilm formation. Similarly, extracts from green tea, rich in catechins like epigallocatechin gallate (EGCG), have been shown to possess strong antifungal activity. These natural compounds are typically formulated into mouth rinses or denture adhesives, providing a therapeutic benefit by reducing the fungal bioburden directly at the denture-mucosa interface, complementing standard hygiene and treatment protocols.

Photodynamic therapy (PDT) represents a significant non-pharmacological advance in treating denture stomatitis, offering a promising alternative with a low risk of inducing microbial resistance. This modality involves the application of a non-toxic photosensitizing agent (e.g., toluidine blue O or methylene blue) to the affected tissues and denture surface. Subsequent activation by a specific wavelength of light, typically from a laser or LED source, generates reactive oxygen species that induce oxidative damage and destroy fungal cells. As highlighted in meta-analyses by Vila-Nova et al. (2023), PDT has proven effective in significantly reducing *Candida* colony counts and alleviating mucosal inflammation. Its localized action and high efficacy make it a valuable option, especially for patients with recurrent infections or contraindications to systemic antifungal drugs.

Beyond treatment modalities, innovations in dental materials science are contributing to the prevention of denture stomatitis. Researchers are actively developing "smart" denture base resins that possess intrinsic antimicrobial properties. This is achieved by incorporating various agents directly into the polymethyl methacrylate (PMMA) matrix, such as silver nanoparticles, quaternary ammonium compounds, or antifungal drugs like fluconazole. The

goal is to create a prosthesis that actively resists microbial colonization and biofilm formation over the long term. While still largely in the experimental phase, these advanced materials could one day provide a built-in preventive mechanism, reducing the reliance on patient compliance with hygiene protocols and offering a more robust defense against the onset of this common oral condition.

6. Local and Systemic Contributing Factors

Local factors directly related to the dental prosthesis are fundamental contributors to the pathogenesis of denture stomatitis. The design, material, and fit of a denture dictate its interaction with the underlying oral tissues. As Vukosavljevic et al. (2023) emphasize, an ill-fitting prosthesis creates areas of excessive pressure and friction, leading to chronic mechanical irritation and inflammation of the mucosa. This physical trauma compromises the epithelial barrier, making it more susceptible to microbial invasion. Furthermore, the porous nature and microscopic surface irregularities of acrylic denture bases provide an ideal scaffold for biofilm accumulation. Therefore, clinical management must include meticulous assessment and correction of these local issues, such as relining the denture or polishing its surface, to create a passive and easily cleanable interface with the mucosa.

The influence of systemic conditions on denture stomatitis underscores the intimate connection between oral and overall health. A patient's systemic status can significantly alter their susceptibility to this oral infection. For instance, uncontrolled diabetes mellitus creates a hyperglycemic environment in oral fluids, which serves as a nutrient source for *Candida* species, promoting their overgrowth. As detailed by Almeida et al. (2022), conditions that cause immunosuppression, such as HIV/AIDS or the use of immunosuppressive drugs for organ transplantation or autoimmune diseases, critically impair the host's ability to mount an effective defense against fungal colonization. This often leads to more severe, persistent, and recurrent forms of denture stomatitis, requiring a more aggressive and often interdisciplinary management approach involving both dental and medical professionals.

Given the interplay of these factors, a comprehensive preventive strategy is essential and must be tailored to the individual patient. The cornerstone of prevention is rigorous patient education on denture hygiene. This includes instruction on daily mechanical brushing of the prosthesis and immersion in a chemical disinfectant, such as dilute sodium hypochlorite or effervescent tablets, to effectively disrupt and remove the microbial biofilm. Equally important is the habit of removing dentures overnight, which allows the palatal tissues to recover and benefit from the cleansing action of saliva. Finally, regular dental check-ups are paramount. These visits allow the clinician to professionally clean the denture, assess its fit, check for any tissue changes, and reinforce hygiene protocols, thereby breaking the cycle of irritation and infection(Mylonas et al., 2022; Peroz & Klein, 2021; Ribeiro et al., 2024).

CONCLUSION

Denture stomatitis is a multifactorial condition requiring a comprehensive therapeutic approach. Topical antifungals—nystatin, miconazole, and clotrimazole—remain first-line for mild to moderate cases, while systemic fluconazole is reserved for severe or refractory infections. Long-term success depends on patient adherence to treatment, optimal denture hygiene, and overnight denture removal. Combining pharmacological and non-pharmacological strategies, such as prosthesis disinfection and behavioral modification, enhances outcomes and prevents recurrence. With concerns over antifungal resistance, future research should optimize dosing, explore novel agents, and integrate adjunctive technologies to improve patient care.

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