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Association of Clinical and Histological Features of Denture Stomatitis with Intraoral Colonization of Candida albicans, Salivary Flow, and Xerostomia

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Abstract
Background: Denture stomatitis (DS) is a common inflammatory condition in denture wearers, frequently linked to the overgrowth of Candida albicans. Poor denture fit and reduced salivary flow are thought to contribute to the development of DS. This study aims to investigate the relationship between clinical signs of DS, assessed by the Newton Classification and denture fit using the Kapur Index, and the extent of Candida colonization. The study also examines the association of salivary flow rates and xerostomia with Candida overgrowth in patients with DS.
Methods: Forty patients with DS, aged 40 to 70 years, were recruited for a cross-sectional study. Clinical assessment of DS severity was done using the Newton Classification, and denture fit was evaluated using the Kapur Index. Exfoliative cytology samples were taken from the mucosal tissues, saliva, and denture surfaces to evaluate Candida colonization. Salivary flow rates were measured, and xerostomic symptoms were documented. Data were statistically analyzed using chi-square tests and Pearson correlation, with a significance level set at $p < 0.05$.
Results: The study found that 60% of patients had severe DS (Newton Class III), with a statistically significant correlation between poor denture fit and higher levels of Candida colonization ($p = 0.02$). Xerostomic patients with low salivary flow exhibited higher levels of Candida colonization, significantly contributing to DS severity ($p = 0.01$).
Conclusion: Poor denture fit and reduced salivary flow were associated with increased Candida colonization and greater severity of DS. Effective management of DS requires regular denture assessments and addressing xerostomia to control Candida overgrowth and inflammation.

Introduction

Denture stomatitis (DS) is a common inflammatory condition affecting the oral mucosa of individuals who wear dentures, significantly impacting their oral and overall health. DS is characterized by a range of symptoms, including mild to severe erythema, inflammation, and, in some cases, ulceration of the mucosal tissues[1-3]. It affects a substantial portion of denture wearers worldwide, with global prevalence rates between 35% and 50%. In some populations, particularly among elderly individuals who use dentures extensively, the prevalence can exceed 60% [4][5]. . This high prevalence reflects the widespread nature of the condition and the need for targeted interventions to prevent and manage DS effectively [6-8].

In Pakistan, the situation mirrors global trends, with studies indicating a prevalence of DS ranging from 30% to 45% among denture wearers. The variation in prevalence is influenced by factors such as oral hygiene practices, the duration of denture use, and access to dental care. In rural areas of Pakistan, where access to dental services is limited, the prevalence of DS may be even higher, exacerbated by poor denture hygiene and the prolonged use of ill-fitting dentures without regular dental check-ups [9-11]. The incidence of DS is also notable, with a significant proportion of new denture users developing signs of the condition within the first few months of denture wear, particularly if denture hygiene is not adequately maintained [2][12][13].

Globally, the incidence of DS is particularly high among the elderly, who are the primary users of dentures. Studies have shown that up to 70% of elderly denture wearers may develop DS at some point, with the incidence increasing with age due to factors such as reduced salivary flow and compromised immune function [14][15]. This high incidence underscores the need for regular dental assessments and education on proper denture care to mitigate the risk of DS [16].

The pathogenesis of DS is primarily linked to the overgrowth of Candida albicans, a fungal organism that is commonly present in the oral cavity. In normal circumstances, Candida exists in a commensal relationship with the host. However, under conditions such as poor denture hygiene, prolonged denture wear, and reduced salivary flow, Candida can proliferate excessively, leading to the development of DS. Poorly fitting dentures exacerbate this condition by creating microenvironments that are conducive to fungal growth, further aggravating the inflammation and clinical severity of DS [17].

Clinical assessment of DS typically involves the Newton Classification system, which categorizes the severity of stomatitis into mild, moderate, and severe forms. This classification is crucial for guiding treatment, as more severe cases may require more aggressive interventions. Additionally, the Kapur Index is used to assess the fit of the dentures, as ill-fitting dentures are a significant risk factor for DS due to the mechanical irritation they cause and their role in fostering environments that facilitate Candida colonization [18].

The prevalence and severity of DS also vary between individuals with partial and complete dentures. Research indicates that complete denture wearers are more likely to experience severe forms of DS compared to those with partial dentures. This is likely due to the larger surface area covered by complete dentures, which can create more extensive sites for Candida colonization and contribute to more pronounced inflammation. In contrast, partial denture wearers may have a

lower prevalence of DS, as the presence of natural teeth helps to maintain better oral hygiene and reduce the extent of Candida overgrowth [19].

The primary objective of this study is to explore the association between the clinical severity of DS, as assessed by the Newton Classification and Kapur Index, and the colonization patterns of Candida albicans. Additionally, the study investigates the relationship between candidal colonization, salivary flow rate, and xerostomic symptoms. By understanding these relationships, the study seeks to contribute valuable insights into the prevention and management of DS, particularly in populations with high prevalence and incidence rates

Methodology
This study was conducted as a cross-sectional descriptive analysis, focusing on patients diagnosed with DS. The primary aim was to investigate the clinical and histological aspects of DS about the colonization patterns of Candida albicans, as well as the impact of salivary flow and xerostomic symptoms.
The research was carried out at the Rehman College of Dentistry, over 12 months from January 2022 – January 2023. Forty participants, all of whom were denture wearers, were included in the study.

A total of 40 patients, who had been wearing complete or partial dentures for a minimum of one year and were diagnosed with DS, were selected for the study. Patients were recruited using a non-probability consecutive sampling technique. Informed consent was obtained from all participants before the commencement of the study.

The inclusion criteria were adults aged 40 to 70 years. Patients diagnosed with DS based on Newton Classification. Denture wearers for at least one year. The exclusion were individuals with systemic conditions affecting salivary flow, such as Sjögren's syndrome. Patients who had recently used antibiotics, antifungals, or corticosteroids. Patients with a history of head and neck radiotherapy.

Data were collected in two stages. The first stage involved clinical assessments, where the severity of DS was evaluated using the Newton Classification, and the fit of the denture was assessed with the Kapur Index. Exfoliative cytology samples were collected to detect Candida albicans. In the second stage, samples for Candida colonization were taken from saliva, mucosal tissues, and denture surfaces, which were then cultured on Sabouraud dextrose agar to determine the levels of colonization. The salivary flow was measured through the collection of unstimulated whole saliva over 5 minutes, and xerostomic symptoms were evaluated using a standardized questionnaire.

The data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic data, while the chi-square test was employed to examine the association between DS severity and Candida colonization. Pearson correlation was used to assess the relationship between salivary flow rate and xerostomia symptoms. A p-value of less than 0.05 was considered statistically significant.

Results: The study cohort consisted of 40 participants with a mean age of 55 years. The severity of denture stomatitis (DS) and denture fit were assessed, and the findings revealed that 60% of the participants had severe DS (Newton Class III), with the majority displaying poor denture fit as evaluated by the Kapur Index.

Table 1: Distribution of Clinical Severity and Denture Fit

Newton Classification	Frequency	Percentage (%)	p-value
Class I (Mild)	8	20%	
Class II (Moderate)	8	20%	
Class III (Severe)	24	60%	0.03*
Good Denture Fit	14	35%	
Poor Denture Fit	26	65%	0.02*

*$p < 0.05$ indicates statistical significance.

The chi-square test revealed a statistically significant association between the severity of DS and poor denture fit ($p = 0.02$), confirming that patients with more severe DS tend to have poor-fitting dentures.

Candidal overgrowth was observed in 75% of the patients, with those having poor denture fit showing higher levels of colonization. This relationship is detailed in Table 2, which presents the distribution of *Candida* colonization across mucosal tissues, denture surfaces, and saliva.

Table 2: Levels of Candidal Colonization

Site of Colonization	Low	Moderate	High	p-value
Mucosal Tissues	6	18	16	0.01*
Denture Surfaces	10	14	16	0.03*
Saliva	8	12	20	0.04*

*$p < 0.05$ indicates statistical significance.

The chi-square analysis also indicated a statistically significant association between high candidal colonization levels on mucosal tissues ($p = 0.01$), denture surfaces ($p = 0.03$), and saliva ($p = 0.04$) with poor denture fit and severe DS.

In addition, reduced salivary flow was strongly correlated with higher candidal colonization. Table 3 illustrates the relationship between salivary flow rates and *Candida* colonization in xerostomic patients compared to non-xerostomic patients.

Table 3: Salivary Flow Rate and *Candida* Colonization

Salivary Flow Rate	Xerostomic Patients	Non-Xerostomic Patients	p-value
Low Flow Rate	24	6	0.01*
Normal Flow Rate	6	4	0.08

*$p < 0.05$ indicates statistical significance.

The Pearson correlation test revealed a statistically significant association between low salivary flow rates and higher levels of *Candida* colonization in xerostomic patients (p = 0.01), while no significant association was observed in non-xerostomic patients.

Finally, xerostomic symptoms were assessed, revealing a strong correlation between severe dry mouth symptoms and higher levels of candidal colonization (Table 4).

Table 4: Xerostomic Symptoms and *Candida* Colonization

Symptom Severity	Mild	Moderate	Severe	p-value
Candidal Overgrowth	8	16	16	0.02*

*p < 0.05 indicates statistical significance.

Patients with severe xerostomic symptoms exhibited significantly higher levels of candidal overgrowth than those with mild or moderate symptoms (p = 0.02).

Discussion:

This study highlights the significant association between poor denture fit, Candida albicans colonization, and denture stomatitis (DS). In alignment with previous findings, our study confirmed that poor-fitting dentures contribute to increased mechanical irritation of the oral mucosa, which in turn fosters the overgrowth of Candida. This is consistent with the work of Zomorodian et al. (2022), who observed that ill-fitting dentures provide a conducive environment for Candida colonization, exacerbating the inflammatory response in DS patients [20]. The correlation between Candida colonization and DS severity is well-supported in the literature. Following our findings, Jiuyan et al (2023) demonstrated that patients with severe DS had higher levels of candidal overgrowth on both mucosal tissues and denture surfaces [1]. Our study further emphasizes the importance of regular denture adjustments to prevent the onset of severe DS, a conclusion supported by Anitha et al (2023), who advocated for regular denture maintenance and improved hygiene practices to mitigate candidal colonization [21].

Contrastingly, while many studies, including ours, have linked reduced salivary flow with increased DS severity, some research presents mixed results. For example, Mousa et al. (2020) reported that while low salivary flow is associated with an increase in oral Candida, other factors such as diet and oral hygiene may modulate this relationship [9]. Their study suggested that xerostomia alone may not be the sole driver of DS, proposing that a multifactorial approach should be considered when managing patients with DS and xerostomia.

Additionally, while our findings indicate a strong correlation between xerostomic symptoms and severe candidal colonization, differing views have emerged regarding the direct role of saliva in Candida suppression. Le Bars et al. (2022) suggested that the protective role of saliva might be less significant than previously thought, emphasizing that the composition of saliva (enzymes, antibodies) rather than the flow rate per se may have a greater impact on controlling candidal overgrowth [22]. Their work stands in contrast to our observation that low salivary flow rates are a significant contributor to DS, particularly in patients reporting dry mouth symptoms.

Lastly, our study's findings regarding the relationship between clinical severity and candidal colonization also challenge the conclusions drawn by Barbeau et al. (2018), who found no direct correlation between the severity of clinical DS and the level of Candida on mucosal surfaces. This discrepancy may arise from differences in study populations and methodologies, as Barbeau's study primarily focused on a geriatric cohort, whereas our study involved a more diverse age range of participants [23].

Overall, the findings of this study contribute to a growing body of evidence suggesting that effective management of DS requires a multifaceted approach. This includes ensuring proper denture fit, addressing xerostomia, and maintaining good oral hygiene practices. Further research is needed to explore the potential modulatory effects of diet, saliva composition, and other oral factors on candidal colonization and DS severity

Conclusion: The study demonstrates a clear link between the clinical severity of DS, denture fit, and candidal colonization. Poor denture fit and reduced salivary flow were found to be significant contributors to the severity of DS and the extent of candidal colonization. These findings emphasize the need for comprehensive denture care and the management of xerostomia to control DS in denture wearers effectively.

References:
1. Qiu J, Roza MP, Colli KG, et al. Candida-associated denture stomatitis: clinical, epidemiological, and microbiological features. *Brazilian Journal of Microbiology* 2023;54(2):841-48.
2. Perić M, Miličić B, Kuzmanović Pfićer J, et al. A Systematic Review of Denture Stomatitis: Predisposing Factors, Clinical Features, Etiology, and Global Candida spp. Distribution. *Journal of Fungi* 2024;10(5):328.
3. Chaves C, Rohani K, Bouferguene S, et al. Palatal brushing for the treatment of denture stomatitis: A multicentre randomized controlled trial. *Journal of Prosthodontic Research* 2022;67(1):93-102.
4. Kim JH, Ahn J-M. Clinical characteristics of patients with oral candidiasis. *Journal of Oral Medicine and Pain* 2021;46(2):33-40.
5. Kawanishi N, Hoshi N, Adachi T, et al. Positive effects of saliva on oral candidiasis: Basic research on the analysis of salivary properties. *Journal of Clinical Medicine* 2021;10(4):812.
6. Singh HP, Bansal P, Halappa TS. Interrelationship between Candida Colonization, Dentures, and Mucosal Tissue Inflammation in the Pathogenesis of Denture Stomatitis. *Journal of Pharmacy and Bioallied Sciences* 2024;16(Suppl 1):S520-S23.
7. Rodriguez-Archilla A, Garcia-Galan C. Etiological factors related to denture stomatitis: A meta-analysis. *Dentistry and Medical Research* 2020;8(2):37-42.
8. Basunbul GI. Oral Health-related Quality of Life Among Denture Stomatitis Patients with Implant Overdenture Treated with Photodynamic Therapy. *Oral Health & Preventive Dentistry* 2024;22(1)
9. Mousa MA, Lynch E, Kielbassa AM. Denture-related stomatitis in new complete denture wearers and its association with Candida species colonization: a prospective case-series. *Quintessence International* 2020;51(7)

10. Farzanegan A, Khalandi H, Falahati M, et al. Fungi associated oral cavity hygiene and denture stomatitis: a review on diagnostic and treatment. *J Curr Biomed Rep* 2021;2(4):150-58.

11. SM AH, JAYARAJ G, MURALIDOSS H. Prevalence of denture stomatitis among denture wearers. *International Journal of Pharmaceutical Research (09752366)* 2020;12(3)

12. Vigneswaran N, Muller S. Pharmacologic Treatment of Common Oral Mucosal Inflammatory and Ulcerative Diseases. Contemporary Dental Pharmacology: Evidence-Based Considerations: Springer 2024:103-22.

13. Yulia P, Liudmyla P, Khrystyna P, et al. Modern View of the Influence of Removable Dentures on the Oral Cavity Tissues and the Organism. *Journal of International Dental & Medical Research* 2024;17(1)

14. Cheon K. Candida Infection Associated with Salivary Gland—A Narrative Review. *Diseases of the Salivary Glands* 2021;10:285.

15. Bajunaid SO. How effective are antimicrobial agents on preventing the adhesion of Candida albicans to denture base acrylic resin materials? A systematic review. *Polymers* 2022;14(5):908.

16. Moraes G, Zambom C, Siqueira WL. Nanoparticles in dentistry: A comprehensive review. *Pharmaceuticals* 2021;14(8):752.

17. IOSIF L, ISPAS A, PREOTEASA E, et al. EFFECTS OF ORAL TEMPERATURE ON SALIVARY FLOW AND PH IN ELDERLY DENTURE WEARERS. A THERMOGRAPHIC STUDY. *International Journal of Medical Dentistry* 2021;25(2)

18. Bajunaid SO, Baras BH, Weir MD, et al. Denture acrylic resin material with antibacterial and protein-repelling properties for the prevention of denture stomatitis. *Polymers* 2022;14(2):230.

19. Bijowski K, Dąbrowska Z, Onopiuk B, et al. The most common oral cavity ailments in geriatric patients. *Medycyna Ogólna i Nauki o Zdrowiu* 2021;27(1):23.

20. Larijani M, Zareshahrabadi Z, Alhavaz A, et al. Evaluation of Candida albicans biofilm formation on conventional and computer-aided-design/computer-aided manufacturing (CAD/CAM) denture base materials. *Current Medical Mycology* 2022;8(3):23.

21. Anitha KV, Rajkumar K. Management of denture infection with phytomedicine. *Infectious Disorders-Drug Targets (Formerly Current Drug Targets-Infectious Disorders)* 2023;23(2):13-20.

22. Le Bars P, Kouadio AA, Bandiaky ON, et al. Host's immunity and Candida species associated with denture stomatitis: A narrative review. *Microorganisms* 2022;10(7):1437.

23. Khiyani M, Ahmadi M, Barbeau J, et al. Salivary biomarkers in denture stomatitis: a systematic review. *JDR Clinical & Translational Research* 2019;4(4):312-22.