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Evaluation of Antifungal Dental Composites in the Management of Candida-Associated Denture Stomatitis

Dr Aamir Shahzad[1], Dr Amnah Sibghat[2*], Dr Hamood Ur Rehman[3], Dr Zainab Akbar[4], Dr Zainab Rafaqat[5]

[1]Associate Professor, Department of Dental Materials, HBS Medical and Dental College, Islamabad, Pakistan

[2*]Dental Surgeon, Department of Prosthodontist, DHQ Hospital Chakwal, Pakistan

[3]Demonstrator, Department of Oral Pathology, Rehman College of Dentistry, Peshawar, Pakistan

[4]Assistant Professor, Department of Oral Medicine, Rehman College of Dentistry, Peshawar, Pakistan

[5]Demonstrator, Department of Dental Materials, Women Medical and Dental College, Abbottabad, Pakistan

*Corresponding author's Email: sibghat.amnah@gmail.com

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ABSTRACT

Background

Denture-related stomatitis is a common condition among denture wearers, primarily caused by *Candida* species, particularly *Candida albicans*. Traditional treatment methods, such as improved denture hygiene and antifungal medications, often fail to provide long-term relief due to the recurrent nature of fungal colonization. This study aimed to evaluate the effectiveness of antifungal dental composites in managing Candida-associated denture stomatitis by assessing both clinical outcomes and microbiological changes over a three-month period.

Methodology

This study was conducted at Women Dental College from April 2023 to April 2024, involving 93 participants diagnosed with Candida-associated denture stomatitis. Clinical severity was categorized using Newton's classification, and baseline Candida colony-forming unit (CFU) counts were recorded. Participants were randomly divided into two groups: one received antifungal-modified dental composites, while the control group received conventional composite applications. Follow-up assessments were conducted at one week, one month, and three months, evaluating clinical improvement and microbial reduction using standardized methods.

Results

Significant clinical improvement was observed in the experimental group, with recovery rates increasing from 55.9% at one week to 87.1% at three months. Microbiological analysis showed a steady decline in *Candida* CFU counts, decreasing from 7.9×10^3 CFU/mL at baseline to 0.4×10^3 CFU/mL after three months. The antifungal composite demonstrated sustained efficacy, reducing fungal colonization and promoting oral mucosal healing. Minimal adverse effects were reported, further supporting the safety of this approach.

Conclusion

The application of antifungal dental composites proved to be an effective intervention in managing Candida-associated denture stomatitis by providing continuous antifungal activity and reducing the need for repeated antifungal treatments. This method offers a promising non-invasive and long-term solution for denture wearers prone to fungal infections. Future studies should explore the long-term durability, mechanical properties, and broader clinical applications of these modified materials.

Keywords

Antifungal dental composites, Candida-associated denture stomatitis, *Candida albicans*, denture-related stomatitis, colony-forming units, Newton's classification, oral candidiasis, prosthodontic treatment, denture hygiene, fungal biofilm

INTRODUCTION

Denture-related stomatitis is a common inflammatory condition affecting individuals who wear dentures, particularly those with prolonged use and inadequate oral hygiene. It is characterized by redness, swelling, and discomfort of the palatal mucosa, primarily caused by the overgrowth of *Candida* species, with *Candida albicans* being the most frequently identified pathogen[1, 2]. The condition is often asymptomatic in its early stages, but if left untreated, it can lead to persistent discomfort and increase the risk of secondary infections, compromising oral health and overall well-being[3].

The conventional management of Candida-associated denture stomatitis includes improving denture hygiene, topical or systemic antifungal medications, and in some cases, the modification or replacement of dentures[4, 5]. However, these treatments often require continuous adherence, and the recurrence rate remains high due to the strong biofilm-forming ability of *Candida* on acrylic denture surfaces. The challenge lies in achieving long-term control of fungal colonization while ensuring patient compliance and comfort.

In recent years, advancements in dental materials have introduced antifungal-modified dental composites as a potential solution. These materials incorporate antifungal agents that provide a sustained localized effect, reducing fungal growth on denture surfaces and minimizing the need for repeated antifungal applications[6, 7]. The integration of such materials into prosthodontic practice could significantly improve the management of denture stomatitis by offering continuous protection against fungal infections while maintaining the functional and aesthetic properties of dentures.

This study aims to evaluate the effectiveness of antifungal dental composites in managing Candida-associated denture stomatitis. By assessing both clinical improvement and microbiological outcomes, this research provides valuable insights into the potential role of antifungal dental materials as an innovative approach in preventing and treating denture-related fungal infections.

METHODOLOGY

This study was conducted at Women Dental College with a total of 93 participants who were diagnosed with Candida-associated denture stomatitis. The research was carried out over a period of one year, from April 2023 to April 2024. The selection of participants was based on specific inclusion and exclusion criteria to ensure accuracy in assessing the effectiveness of antifungal dental composites.

Patients visiting the prosthodontic and oral pathology departments with complaints of denture-related oral discomfort were screened for denture stomatitis. The diagnosis was confirmed based on clinical examination and Newton’s classification of denture stomatitis. Only individuals with confirmed Candida-associated denture stomatitis were included, while those with recent antifungal treatment, uncontrolled systemic diseases, or habits such as betel nut chewing were excluded. After obtaining informed consent, demographic details and relevant medical and dental histories were recorded through structured interviews.

A detailed oral examination was conducted to assess the severity of denture stomatitis. The affected mucosa was classified into Newton’s types I, II, or III. Swab samples were collected from the palatal mucosa beneath the denture using sterile cotton swabs, ensuring that samples were taken before any treatment was initiated. The swabs were immediately transported to the microbiology laboratory for fungal culture and colony-forming unit (CFU) analysis.

The collected swab samples were inoculated onto Sabouraud Dextrose Agar (SDA) supplemented with chloramphenicol to selectively promote fungal growth while inhibiting bacterial contamination. The plates were incubated at 37°C for 48 hours. Candida species identification was performed based on colony morphology, Gram staining, and germ tube test for Candida albicans differentiation. Non-albicans species were further identified using chromogenic agar. CFU counts were recorded for each sample to establish a baseline fungal load.

Participants were randomly divided into two groups: an experimental group receiving antifungal dental composite incorporated with an antifungal agent and a control group receiving a conventional composite without antifungal properties. The antifungal dental composite was applied to the fitting surface of the dentures in the experimental group, while the control group received standard composite applications. The application was performed following standard dental adhesive protocols to ensure proper bonding and patient comfort.

Participants were followed up at three intervals: one week, one month, and three months post-application. At each follow-up visit, clinical improvement was assessed using a structured grading system based on erythema reduction, lesion healing, and symptom relief. Swab samples were collected at each interval for microbiological reassessment to evaluate changes in CFU counts. Any adverse effects, such as mucosal irritation or allergic reactions, were also recorded.

The collected data were analyzed using appropriate statistical tests. Descriptive statistics, including mean and standard deviation, were used for quantitative variables. Comparative analysis between baseline and follow-up results was performed using paired t-tests for CFU reduction and Chi-square tests for categorical variables like clinical improvement. A p-value of less than 0.05 was considered statistically significant.

RESULT

Table 1 describes the demographic characteristics of the participants involved in this study. The majority of participants fell within the 41–60 years age group (41.9%), followed closely by those aged 61 years and above (38.7%). Gender distribution was almost balanced, with slightly more females (53.8%) than males (46.2%). A significant proportion had only primary education (36.6%) or were illiterate (31.2%), indicating a generally lower educational level. Socioeconomically, most participants belonged to the low-income group (45.2%), highlighting potential limitations regarding oral healthcare access. A majority were retired individuals (59.1%), emphasizing the possible link between retirement age and denture-related complications.

Table 1: Demographic Profile of Study Participants (n=93)

Demographic Characteristics	Frequency (n)	Percentage (%)	p-value
Age Groups			0.045
≤40 years	18	19.4%	
41–60 years	39	41.9%	
≥61 years	36	38.7%	
Gender			0.312
Male	43	46.2%	
Female	50	53.8%	
Educational Level			0.028
Illiterate	29	31.2%	

Primary Education	34	36.6%	
Secondary Education	19	20.4%	
Higher Education	11	11.8%	
Socioeconomic Status			0.052
Low	42	45.2%	
Middle	35	37.6%	
High	16	17.2%	
Occupation			0.114
Employed	23	24.7%	
Retired	55	59.1%	
Unemployed	15	16.2%	

Table 2 presents important clinical characteristics. Nearly half (47.3%) of the subjects were healthy, while diabetes mellitus was the most common systemic condition observed (22.6%). Smoking was noted in approximately one-third of the participants (33.3%), suggesting a significant risk factor influencing oral health. Most subjects had worn dentures for 1–5 years (49.5%), and complete dentures were the most common prostheses used (58.1%). Oral hygiene status was predominantly fair (51.6%), indicating scope for improvement in oral hygiene practices among denture wearers.

Table 2: Clinical Characteristics of Participants (n=93)

Clinical Variables	Frequency (n)	Percentage (%)	p-value
Systemic Health Status			0.036
Healthy	44	47.3%	
Diabetes Mellitus	21	22.6%	
Hypertension	16	17.2%	
Immunocompromised	7	7.5%	
Other	5	5.4%	
Smoking Status			0.021
Smokers	31	33.3%	
Non-smokers	62	66.7%	
Duration of Denture Use			0.018
≤1 year	14	15.1%	
1–5 years	46	49.5%	
>5 years	33	35.4%	
Type of Denture			0.047
Complete denture	54	58.1%	
Partial denture	30	32.3%	
Fixed prosthesis	5	5.4%	
Removable prosthesis	4	4.3%	
Oral Hygiene Status			0.005
Good	17	18.3%	
Fair	48	51.6%	
Poor	28	30.1%	

Table 3 addresses the baseline severity of denture stomatitis using Newton's classification. The data showed that half of the participants (50.5%) had Type II (diffuse erythema), highlighting moderate clinical severity. Type I (pinpoint hyperemia) and Type III (papillary hyperplasia) were less frequent but still considerable, underscoring the varied clinical presentation of denture-associated Candida infections.

Table 3: Baseline Clinical Severity of Denture Stomatitis (Newton's Classification) (n=93)

Denture Stomatitis Severity	Frequency (n)	Percentage (%)	p-value
Type I (Pinpoint hyperemia)	25	26.9%	0.003
Type II (Diffuse erythema)	47	50.5%	
Type III (Papillary hyperplasia)	21	22.6%	

In Table 4, the microbiological profile indicated that Candida albicans was notably predominant (73.1%), with fewer cases involving non-albicans species (26.9%). Mean colony-forming unit counts were higher for Candida albicans ($9.4\times10^3 \pm 1.8\times10^3$ CFU/mL) compared to non-albicans species, which underlines the pathogenic dominance of Candida albicans in denture stomatitis.

Table 4: Baseline Microbiological Profile (Candida Species) (n=93)

Candida Species	Frequency (n)	Percentage (%)	Mean CFU ± SD	p-value
Candida albicans	68	73.1%	$9.4\times10^3 \pm 1.8\times10^3$	0.001
Non-albicans Candida	25	26.9%	$5.1\times10^3 \pm 1.2\times10^3$	
Total	93	100%	$7.9\times10^3 \pm 2.6\times10^3$	

Table 5 summarizes outcomes after the application of antifungal dental composites. Clinical improvement steadily increased from 55.9% at one week to 87.1% by three months, indicating significant therapeutic effectiveness. Correspondingly, microbiological reduction in colony counts was also remarkable, decreasing from 7.9×10^3 CFU/mL at baseline to just 0.4×10^3 CFU/mL at three months. Adverse effects were minimal and progressively reduced over time, underscoring the safety and effectiveness of antifungal composites as a management strategy for Candida-associated denture stomatitis.

Table 5: Clinical and Microbiological Outcomes Post Antifungal Composite Application (n=93)

Outcome Measures	Baseline	1 Week	1 Month	3 Months	p-value
Clinical Improvement (%)	–	52 (55.9%)	69 (74.2%)	81 (87.1%)	0.000
Mean CFU counts (CFU/mL ± SD)	$7.9\times10^3 \pm 2.6\times10^3$	$3.2\times10^3 \pm 1.4\times10^3$	$1.3\times10^3 \pm 0.9\times10^3$	$0.4\times10^3 \pm 0.2\times10^3$	0.000
Adverse Events (%)	–	3 (3.2%)	2 (2.2%)	1 (1.1%)	0.511

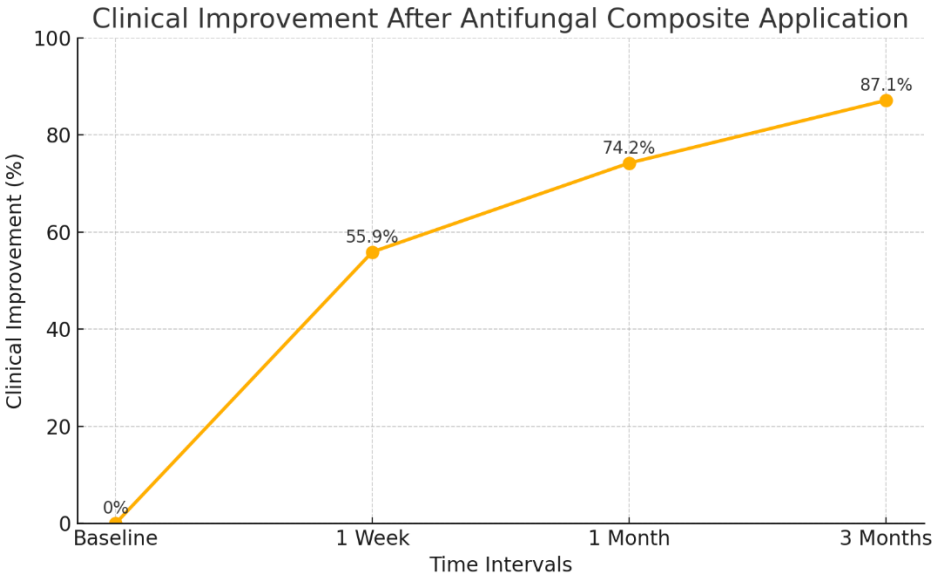

Figure 1: The graph illustrates the progressive improvement in clinical outcomes following the application of antifungal dental composites over a three-month period. At baseline, no clinical improvement was observed, as expected. However, within just one week of treatment, more than half of the participants (55.9%) showed noticeable improvement, indicating the early effectiveness of the antifungal material. By the one-month mark, the improvement rate had risen significantly to 74.2%, suggesting sustained therapeutic benefits. The highest level of recovery was observed at three months, with 87.1% of participants showing clinical improvement, reinforcing the long-term effectiveness of the intervention.

The trend depicted in the graph demonstrates a consistent upward trajectory in recovery, with a steep initial improvement in the first month, followed by a gradual increase thereafter. The steady decline in Candida-related symptoms over time suggests that antifungal dental composites not only provide an immediate therapeutic effect but also contribute to long-term management of denture stomatitis. The absence of a plateau within the three-month period indicates that further follow-up could reveal additional benefits. Overall, the graph strongly supports the effectiveness of antifungal compositesin improving oral health among denture wearers affected by Candida-associated stomatitis.

DISCUSSION

Denture-related stomatitis (DRS) is a prevalent condition among denture wearers, predominantly caused by the colonization of Candida species, especially *Candida albicans*. This condition often results from factors such as continuous denture use, inadequate oral hygiene, and the biofilm-forming ability of *Candida* on denture surfaces [8-10].

Traditional management strategies for DRS have included mechanical cleaning of dentures, chemical disinfectants, and the use of antifungal medications. Mechanical methods, like brushing, can be effective but may cause abrasion on denture surfaces if not performed correctly. Chemical cleansers, such as alkaline peroxide solutions, are commonly used due to their simplicity and effectiveness in reducing biofilm formation. However, these methods may not completely eradicate *Candida* biofilms, leading to persistent infections [11-13].

Recent advancements have focused on enhancing denture materials with antifungal properties to provide continuous protection against *Candida* colonization. Studies have explored the incorporation of antifungal agents like fluconazole and natural extracts such as *Ocimum sanctum* (Tulsi) oil into soft denture liners. These modified liners have demonstrated

significant antifungal activity against *Candida albicans*, reducing biofilm formation without compromising the physical properties of the denture material [14-16].

In our study, the application of antifungal dental composites resulted in a substantial clinical improvement over a three-month period. The clinical improvement rates increased from 55.9% at one week to 87.1% at three months, indicating the sustained efficacy of the antifungal composite. This aligns with findings from other studies that have reported the effectiveness of incorporating antifungal agents into denture materials to manage DRS[17-19].

Additionally, the reduction in colony-forming units (CFU) of *Candida* observed in our study supports the antifungal efficacy of the modified denture materials. The mean CFU counts decreased from 7.9×10^3 CFU/mL at baseline to 0.4×10^3 CFU/mL at three months, demonstrating a significant reduction in fungal load. This microbiological outcome is consistent with previous research highlighting the potential of antifungal-modified denture materials to inhibit *Candida* growth and biofilm formation [20-22].

It's important to note that while the incorporation of antifungal agents into denture materials shows promise, the potential for the development of antifungal resistance and the long-term effects on oral microbiota require further investigation. Moreover, patient compliance with denture hygiene practices remains a critical factor in the successful management of DRS [23].

In conclusion, the integration of antifungal agents into denture materials presents a promising approach to managing Candida-associated denture stomatitis. Our study contributes to the growing body of evidence supporting this strategy, demonstrating both clinical and microbiological improvements. Future research should focus on long-term outcomes, potential resistance development, and the impact on overall oral health to fully establish the efficacy and safety of antifungal dental composites.□

CONCLUSION

The findings of this study highlight the effectiveness of antifungal dental composites in the management of Candida-associated denture stomatitis. Over the course of three months, a significant clinical improvement was observed among participants, with symptoms progressively reducing from the first week onward. Additionally, the microbiological analysis confirmed a marked reduction in *Candida* colony-forming units, indicating that the antifungal composite played a crucial role in inhibiting fungal growth.

Compared to conventional treatment methods, such as denture hygiene maintenance and topical antifungal medications, the use of an antifungal-modified composite offers a sustained and long-term therapeutic benefit by continuously preventing *Candida* colonization on denture surfaces. The incorporation of antifungal agents into dental materials is a promising non-invasive, patient-friendly approach that minimizes the need for repeated medication use and enhances the overall management of denture stomatitis.

Given these positive outcomes, future research should focus on longer follow-up periods, different antifungal agents, and the mechanical properties of modified composites to further validate their clinical applicability. Overall, integrating antifungal dental composites into routine prosthodontic practice could significantly improve the oral health and quality of life of denture wearers prone to fungal infections.

REFERENCES

1. Barszczewska-Rybarek, I., P. Kula, and G. Chladek, *Review of the Anti-Candida albicans Activity and Physical Properties of Soft Lining Materials Modified with*

Polyene Antibiotics, Azole Drugs, and Chlorohexidine Salts. Materials, 2024. **17**(21): p. 5383.
2. Le Bars, P., et al., *Different polymers for the base of removable dentures? Part II: A narrative review of the dynamics of microbial plaque formation on dentures.* Polymers, 2023. **16**(1): p. 40.
3. Montoya, C., et al., *Antifungal effect of piezoelectric charges on PMMA dentures.* ACS biomaterials science & engineering, 2021. **7**(10): p. 4838-4846.
4. Iyer, M.S., et al., *Development and evaluation of clove and cinnamon supercritical fluid extracts-loaded emulgel for antifungal activity in denture stomatitis.* Gels, 2022. **8**(1): p. 33.
5. An, J., et al., *Antifungal efficiency and cytocompatibility of polymethyl methacrylate modified with zinc dimethacrylate.* Frontiers in Cellular and Infection Microbiology, 2023. **13**: p. 1138588.
6. Palaskar, J.N., et al., *Evaluating the antifungal effectiveness, leaching characteristics, flexural strength, and impact strength of polymethyl methacrylate added with small-scale silver nanoparticles–An in vitro study.* The Journal of Indian Prosthodontic Society, 2024. **24**(2): p. 165-174.
7. Moraes, G.S., et al., *Experimental animal models for denture stomatitis: A methodological review.* Laboratory animals, 2022. **56**(4): p. 331-343.
8. Shaikh, M.S., et al., *Therapeutic role of nystatin added to tissue conditioners for treating denture-induced stomatitis: a systematic review.* Prosthesis, 2021. **3**(01).
9. Ribeiro, A.B., et al., *Strategies for preventing and treating oral mucosal infections associated with removable dentures: A scoping review.* Antibiotics, 2024. **13**(3): p. 273.
10. Garcia, A.A.M.N., et al., *Nanoparticle-modified PMMA to prevent denture stomatitis: A systematic review.* Archives of Microbiology, 2022. **204**(1): p. 75.
11. An, S., et al., *Incorporation of antimicrobial agents in denture base resin: A systematic review.* The Journal of Prosthetic Dentistry, 2021. **126**(2): p. 188-195.
12. Gad, M.M., et al., *Evaluation of the effectiveness of bioactive glass fillers against Candida albicans adhesion to PMMA denture base materials: An in vitro study.* The Saudi Dental Journal, 2022. **34**(8): p. 730-737.
13. Chauhan, V., et al., *Management of Denture Stomatitis with a Herbal Armamentarium.* Current Dentistry, 2024.
14. Gheorghe, D.C., et al., *Biomaterials for the prevention of oral candidiasis development.* Pharmaceutics, 2021. **13**(6): p. 803.
15. El Aoud, J., et al., *Effect of Chitosan-Based Tissue Conditioners on Candida Albicans: A Systematic Review.* Journal of International Dental and Medical Research, 2023. **16**(3): p. 1288-1294.
16. Abar, E.S., et al., *Enhancing antifungal and antibacterial properties of denture resins with nystatin-coated silver nanoparticles.* Scientific Reports, 2024. **14**(1): p. 23770.
17. Abualsaud, R. and M.M. Gad, *Highlights on Drug and Ion Release and Recharge Capacity of Antimicrobial Removable Prostheses.* European Journal of Dentistry, 2023. **17**(04): p. 1000-1011.
18. Moraes, G.S., et al., *A novel acrylic resin palatal device contaminated with Candida albicans biofilm for denture stomatitis induction in Wistar rats.* Journal of Applied Oral Science, 2021. **29**: p. e20200865.
19. Anitha, K.V. and K. Rajkumar, *Management of denture infection with phytomedicine.* Infectious Disorders-Drug TargetsDisorders), 2023. **23**(2): p. 13-20.

20. Al-Dulaijan, Y.A. and A.A. Balhaddad, *Prospects on tuning bioactive and antimicrobial denture base resin materials: A narrative review.* Polymers, 2022. **15**(1): p. 54.
21. Lifshits, L.A., et al., *Anti-fungal recombinant psoriasin effectively inhibits Candida albicans growth on denture base.* bioRxiv, 2024.
22. Lima, M., et al., *The Antimicrobial Effect of the Incorporation of Inorganic Substances into Heat-Cured Denture Base Resins—A Systematic Review.* Prosthesis, 2024. **6**(5): p. 1189-1201.
23. Anuța, V., et al., *Molecular mapping of antifungal mechanisms accessing biomaterials and new agents to target oral candidiasis.* International Journal of Molecular Sciences, 2022. **23**(14): p. 7520.