

EFFECT OF REMOVABLE PARTIAL DENTURES ON ORAL MICROBIOME CHANGES: A SYSTEMATIC REVIEW

Andreea Gheban¹, Vieru Marina^{1*}, Forna Norina²

¹ DDS, Resident, Faculty of Dental Medicine, University of Medicine and Pharmacy "Grigore T. Popa", Iasi

² "Gr. T. Popa" U.M.Ph. - Iasi, Romania, Faculty of Dentistry, Department of Implantology, Removable Dentures, Dentures Technology

Corresponding authors: Vieru Marina, e-mail: drvieru.marina1998@gmail.com

ABSTRACT

Background: Removable partial dentures (RPDs) remain a widely used treatment option for the rehabilitation of partially edentulous patients. However, the presence of denture surfaces and retentive components can influence the oral microbial environment and promote biofilm accumulation.

Objective: To systematically review the available evidence regarding the impact of removable partial dentures on oral microbial colonization and the associated changes in the oral microbiota.

Materials and methods: A systematic literature search was conducted in electronic databases to identify studies evaluating microbial colonization in patients wearing removable partial dentures. Original human studies assessing oral microorganisms, biofilm formation, microbial diversity, or *Candida* colonization associated with RPD use were considered eligible. Review articles and in vitro studies were excluded. Data regarding study design, sample characteristics, microbiological assessment methods and main outcomes were extracted and qualitatively analyzed.

Results: A total of 14 studies met the inclusion criteria and were included in the qualitative synthesis. The included studies comprised observational, comparative and interventional designs. The findings consistently demonstrated increased microbial accumulation on removable partial dentures, particularly in retentive areas prone to plaque retention. Several studies reported a higher prevalence of *Candida* species among RPD wearers, while others identified increased levels of cariogenic microorganisms such as lactobacilli. Evidence also suggested that microbial diversity and biofilm formation increased following denture insertion. Interventional studies showed that denture cleansers, disinfectants and antifungal agents were effective in reducing microbial colonization and biofilm accumulation.

Conclusion: The available evidence suggests that removable partial dentures may favor microbial adhesion, biofilm formation and colonization by opportunistic and cariogenic microorganisms. Proper denture hygiene and regular maintenance are essential to minimize these microbiological changes and support oral health in RPD wearers.

Keywords: removable partial denture; oral microbiota; oral microbiome; biofilm; *Candida*; microbial colonization; dental hygiene.

INTRODUCTION

Removable partial dentures (RPDs) remain a popular treatment option for the rehabilitation of extensive partial edentulism, particularly in cases where fixed or implant-supported protection is contraindicated due to anatomical, systemic or financial limitations. The aging population is increasing

worldwide. There is an increase in the number of risk factors for oral disease and tooth loss in the elderly. [1] In developed countries, analysis of epidemiological data on levels of edentulism and the social and economic impact of tooth loss suggests a global need for removable partial dentures. [4]

Despite their benefits, RPDs comprise retentive surfaces that may facilitate plaque accumulation and microbial adhesion. Changes in the oral microbiome associated with RPD wear may influence the composition and distribution of oral microorganisms. Previous studies have reported increased colonization by *Candida* species, cariogenic bacteria, and periodontal pathogens in RPD wearers. The oral cavity hosts a complex and diverse microbiota, second only to the gut in terms of microbial richness, with over 700 species and 1,300 bacterial strains, as well as a variety of fungi, archaea, and viruses. In a healthy state, this community is dominated by commensal bacteria, such as *Streptococcus*, *Actinomyces*, *Haemophilus*, and *Neisseria*, which collectively maintain a dynamic balance with the host. This balance is essential for symbiosis, supporting normal immune and metabolic functions in the oral environment. The introduction of removable partial dentures (RPDs) can disrupt this balance by providing new surfaces for microbial colonization and modifying the local microenvironment. The presence of RPDs can create niches that favor the accumulation and persistence of pathogenic microorganisms, thus disrupting the stability of the commensal-dominated microbiota and predisposing the oral cavity to dysbiosis [15]. *Candida albicans* is the most common and pathogenic species involved in the development of denture stomatitis. *Candida tropicalis*, *Candida krusei*, *Candida parapsilosis* and *Candida guilliermondii* may also be involved in the development of the disease, but *C. albicans* accounts for over 80% of clinical isolates. [5] Oral candidiasis is also known as denture stomatitis or erythematous candidiasis when it occurs in cases related to complete dentures or removable partial dentures. Denture stomatitis is the most common infectious

disease affecting the mucosa of the palate and alveolar ridge that is in direct contact with the denture base.[5] However, scientific data remain insufficient regarding the alteration of the microbiome specifically associated with removable partial dentures.

While the relationship between complete dentures and changes in the oral microbiome has been extensively studied, results regarding the impact of RPD on the oral microbiome remain fragmented. There is a gap in the literature regarding a thorough synthesis of available clinical findings. In conclusion, the purpose of this literature review is to evaluate the clinical scientific data studying the impact of removable partial dentures on the colonization of the oral microbiome and to summarize the microbial changes reported in adult removable denture wearers.

MATERIALS AND METHODS

This study was conducted as a systematic review of the available clinical literature investigating the effects of removable partial dentures on oral microbial colonization.

The review question was formulated according to the PICO framework: Population (P)- adult patients wearing removable partial dentures, Intervention/exposure (I)- use of removable partial dentures, Comparison (C) - non-denture wearers or baseline oral conditions, Outcome (O)- changes in oral microbial colonization, including bacterial and fungal species.

SEARCH STRATEGY

A comprehensive search was performed in PubMed and Web of Science databases.

The following search strategy was used in PubMed: (“partial denture” OR “removable partial denture” OR “removable partial

dentures” OR “RPD”) AND (“oral microbiome” OR “microbiota” OR “biofilm” OR “Candida” OR “Candida albicans” OR “bacterial colonization”)

ELIGIBILITY CRITERIA

INCLUSION CRITERIA

Studies were included if they investigated adult patients wearing removable partial dentures, evaluated oral microbial colonization or microbiological changes, were clinical human studies, were published in English, provided sufficient methodological and outcome data.

Clinical and observational studies on humans that aimed to evaluate microbial colonization associated with removable partial dentures were eligible for inclusion.

EXCLUSION CRITERIA

Articles were excluded based on criteria such as whether they studied only complete dentures, whether they were conducted in animals or in vitro, whether they were case reports, conference abstracts, literatures reviews, editorials or letters and whether they did not report results discussing microbiological changes.

STUDY SELECTION

All retrieved records were screened based on title and abstract. Potentially eligible studies were included in the final qualitative synthesis.

DATA EXTRACTION

Data extracted from each study included “author and year of publication”. “country of origin”, “study design”, “sample size”, “characteristics of removable partial dentures”, “microbiological assessment methods”, “main microbiological findings”.

RESULTS

Through the literature search, 25 studies were identified. After screening, 4 synthesis studies and 5 in vitro studies were excluded. After thorough evaluation of the texts, 2 other studies were excluded because they did not meet the predefined criteria. In total, 14 studies met the eligibility criteria and were included in the systematic synthesis. Of these, 9 were observational studies and 5 were interventional studies.

CHARACTERISTICS OF THE INCLUDED STUDIES

Fourteen studies met the inclusion criteria and were included in the qualitative synthesis. The included studies comprised observational, comparative and interventional designs. Sample sizes ranged from 11 to 163 participants. The studies evaluated microbial colonization associated with removable partial dentures using culture-based methods, Dentocult tests, plaque sampling and molecular analyses. The most frequently investigated microorganisms were *Candida* spp., lactobacilli, streptococci and other biofilm-associated microorganisms. The characteristics of the included studies are summarized in Table 1.

TABLE 1. Characteristics of the included studies

Author	Sample size	Denture type	Microorganisms evaluated	Main findings
Tanaka et al. (2010)	64/49	RPD vs fixed prothesis	Lactobacilli, streptococci mutans,	Higher lactobacilli counts associated with RPD

			Candida	use and tooth loss
Tasso et al. (2020)	28	RPD	Candida albicans	Liquid soaps effectively reduced Candida colonization
Dias et al. (2018)	12	Complete and partial dentures	Candida spp.	Linalool showed antifungal activity against Candida species
Gao et al. (2002)	16	Acrylic and metal RPDs	Candida, lactobacilli, oral microflora	RPDs promoted microbial accumulation regardless of material
Tanaka et al. (2009)	22	RPD vs fixed prosthesis	Lactobacilli	RPD wearers showed significantly higher lactobacilli levels
Pereira-Cenci et al. (2013)	72	RPD and complete dentures	Candida spp.	Candida levels decreased after denture replacement but remained prevalent

Iosif et al. (2024)	Not reported	RPD	Mixed oral microbiota	Retentive areas accumulated more plaque and pathogenic microorganisms
Bannwart et al. (2022)	15	RPD	Streptococcus spp., Candida spp., S. aureus	Dentures acted as reservoirs for potentially pathogenic microorganisms
Alkmur et al. (1992)	163	RPD, complete dentures, dentate controls	Candida albicans	RPD use was associated with increased Candida prevalence
AlHamdan et al. (2021)	25	Co-cr RPDs	Candida albicans, S. aureus, S. mutans	Chlorhexidine and hematoxylin showed strong antimicrobial effects
Lucena-Ferreira et al. (2013)	25	RPD	Mixed denture biofilm	Denture cleansers significantly reduced microbial counts
Gusmão et al. (2011)	40	RPD	Candida albicans	High prevalence of Candida

				among RPD wearers
Rajendran et al. (2022)	60	RPD	Candida albicans	Daily denture cleansing significantly reduced Candida counts
Costa et al. (2017)	11	Manibular RPD	43 microbial species	Significant increase in microbial diversity after 180 days

1. CANDIDA COLONIZATION

Candida species were among the most frequently investigated microorganisms. Most studies reported increased Candida colonization in patients with RPD. An increased prevalence of Candida albicans was observed in the saliva of RPD patients and suggested a stronger association with acrylic dentures. [11] A qualitative reduction of Candida was reported following replacement of old dentures with new ones, but colonization remained detectable in removable denture wearers. [6] Candida species were identified on all removable dentures evaluated, while others have shown that regular denture hygiene significantly reduces Candida colonization.[8]

Collectively, the results obtained suggest that RPD provides favorable conditions for fungal colonization, especially when hygiene measures are inadequate.

2. BIOFILM FORMATION AND MICROBIAL DIVERSITY

Multiple studies have demonstrated increased biofilm accumulation associated with the wearing of removable partial dentures. A progressive accumulation on denture surfaces has been reported after only 3 months of immediate adaptation, regardless of the material used to make the denture.[4] A significant amplification of microbial species in the subgingival biofilm was observed after 6 months of removable partial denture wear, including streptococci, Aggregatibacter actinomycetemcomitans, Prevotella spp. and Candida spp..

Iosif et al. observed the distribution of heterogeneous microbial plaque on denture surfaces, especially in the retentive areas. Similarly, extensive colonization of dentures by streptococci and Candida species was evidenced.[8]

3. CARIOGENIC MICROORGANISMS

Several studies have reported an increase in the overall microbial load after RPD insertion. There are significantly higher levels of lactobacilli in patients wearing RPD compared to patients with fixed dentures. [1] The quantitative increase in lactobacilli is associated with increased tooth loss and a potential increased cariogenic risk. Similar findings were reported in a subsequent study that evaluated oral microbial profiles according to the type of prosthetic rehabilitation. These results indicate that RPD may alter the oral ecological balance by promoting microbial retention and the abundance of cariogenic microorganisms.

4. MICROBIAL CONTROL STRATEGIES

Other studies have evaluated methods for reducing microbial colonization associated with removable partial dentures. Liquid soaps have been reported effective in reducing contamination of prosthetic surfaces with *Candida albicans*. [2] Similarly, a significant reduction in microbial counts has been demonstrated after regular use of denture cleaning agents. Daily cleaning of dentures using cleaning and disinfection protocols has significantly reduced *Candida* colonization. [12] Linalool also has antifungal properties against *Candida* species, particularly *Candida krusei*. [3] Different disinfection protocols for Cr-Co dentures have been evaluated and reported that chlorhexidine and hematoporphyrin- based treatments were effective against *Candida albicans*, *Streptococcus mutans* and *Staphylococcus aureus*. [9]

Overall, the available evidence suggests that regular denture hygiene measures and the use of appropriate disinfectant agents can significantly reduce microbial colonization and biofilm accumulation on removable partial dentures.

DISCUSSION

1. PRINCIPLE FINDINGS

The current systematic review assessed the impact of removable partial dentures on the colonization of the oral microbiome. The results found indicate that the retentive areas of removable partial dentures can promote microbial accumulation. Increased colonization by *Candida albicans*, lactobacilli and the other potential pathogens has been reported in several studies. Also, the heterogeneity of the accumulated biofilm

tended to increase after denture insertion, especially in the retentive areas.

2. CANDIDA COLONIZATION

One of the most common findings of the included studies is the increased prevalence of *Candida* species in removable partial dentures wearers. Prosthetic surfaces provide a favorable environment for fungal adhesion and biofilm development. Significant levels of *Candida* colonization have been reported, thus supporting the hypothesis that removable partial dentures may alter the oral microbial ecosystem and facilitate fungal growth. [6,8,11]

3. BIOFILM FORMATION AND MICROBIAL DIVERSITY

Several studies have shown that removable partial dentures promote biofilm accumulation and increased microbial diversity. Microbial accumulation occurs regardless of the nature of the prosthetic material. [4] Other authors have observed a significant increase in the number of microbial species after 6 months of denture wear. [14] Similarly, plaque accumulation was found to be more evident in the retentive areas of dentures. These findings suggest that denture design and denture surface characteristics may contribute to the establishment of complex microbial communities. [7]

4. CARIOGENIC POTENTIAL OF REMOVABLE PARTIAL DENTURES

Studies have identified higher levels of lactobacilli in patients wearing removable partial dentures compared to patients wearing fixed dentures. Given that lactobacilli are associated with cariogenic progression, these studies may also indicate an increased cariogenic risk in patients wearing removable

partial dentures. [1] This observation highlights the importance of primary prevention in these patients.

5. CLINICAL IMPLICATIONS

From a clinical perspective, the aforementioned findings highlight the importance of meticulous denture hygiene and routine check-ups. The included interventional studies demonstrated that denture cleaning and disinfection agents and antifungal agents can effectively reduce microbial colonization. In conclusion, patient education regarding denture hygiene should be considered.

6. LIMITATIONS

The presented systematic review had some limitations. The included studies showed

substantial heterogeneity in terms of study types, samples, microbiological methods and outcomes. Also, many studies had relatively small sample sizes and short follow-up periods.

CONCLUSION

Within the limits of available evidence, removable partial dentures appear to promote microbial accumulation and biofilm formation, particularly by increasing colonization by *Candida* and cariogenic microorganisms such as lactobacilli. Proper denture hygiene and regular maintenance are essential to minimize these microbiological changes and maintain oral health.

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