

Relationship between removable prosthesis and some systemics disorders

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Abstract

This article reviews the dental literature concerning the potential impact of the removable prosthesis (RP) on the health status of patients with certain systemic diseases. Literature was surveyed using Medline/PubMed database resources, as well as a manual search, up to 2015 to identify appropriate articles that addressed the aim of this review. The research used keywords about associations between RP and six pathologies: Human immunodeficiency virus infection, diabetes mellitus, pulmonary diseases, gastric-*Helicobacter pylori*, cancer, and cardiovascular diseases. Analysis of literature showed that in patients with dentures having one or more of the six general conditions listed, *Candida albicans* organism is more frequently found in the oral flora compared to healthy denture wearer. Although causality has not been established and pending further research on this topic, the hygienic practices necessary to minimize the risk of numerous pathologies should be strengthened in the case of these patients, all the more in the presence of physical or psychological disability. The relationship between the general diseases and increasing of oral candidiasis denture patients is not explained. Therefore, attention to oral hygiene and professional care for removing *C. albicans* may be beneficial in these medically compromised patients.

Key Words: Cardiovascular diseases, diabetes mellitus, gastrointestinal diseases, human immunodeficiency virus, pulmonary diseases, removable prosthesis

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INTRODUCTION

In medically compromised patients, the knowledge of pathologies related or possibly induced by prosthetic microbial plaque is essential for maintaining the oral health and preventing possible complications.^[1,2]

Denture plaque (DP) is defined as a dense microbial layer comprised of microorganisms and their metabolites.^[3] It

contains more than 10^{11} organisms per gram in wet weight and has essentially the same structure as dental plaque on natural teeth.^[4,5] The composition of these microbial flora also resembles that of dental plaque, except for an increased number of *Candida spp.* *Candida* biofilm on dentures leading to a decrease in the bacterial diversity and then to a qualitative change in the

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composition of the oral microbiota.^[6] DP containing *Candida* could give rise to denture-induced stomatitis, root caries, and periodontitis.^[7-9] In addition, if the oral mucosa is weakened, the friction of the prosthesis can facilitate the breaking of the epithelial barrier and increase the risk of the passage of germs into the bloodstream.^[10] Moreover, the continuous swallowing or respiration of microorganisms from DP exposes patients, particularly the immunocompromised host or polymedicated elderly, to the risk of unexpected infections.

Clinical studies are needed to confirm the existence of this risk and demonstrate the effectiveness of prosthetic biofilm control in these patients.^[11,12]

The aim of this paper is to investigate the putative risks related to medically compromised patients wearing a removable prosthesis (RP).^[13,14]

In this way, the purpose of our literature analysis is to review the knowledge about this subject with. An electronic database and manual searches were undertaken to identify the impact of prostheses on the oral flora of patients with one or more common six general pathologies. Association only between denture wearers (DWs) and in order “human immunodeficiency virus (HIV),” “diabetes mellitus,” “diabetic,” “pulmonary, pneumonia, diseases” “gastric-*Helicobacter pylori*,” “cancer,” and “cardiovascular diseases,” are conducted. Two reviewers independently analyzed the article selection. We found 232 references directly or indirectly concerned by the subject.

First, we will detail the literature data according to each of the systemic pathologies, and we will discuss these results in a second part.

MATERIALS AND METHODS

In this work, we chose to treat the most documented systemic diseases related to this issue. Moreover, it seems impractical to consider a comprehensive review of all systemic diseases. Based on recent publications, we limited our search to the main diseases that can be linked to a removable denture (RD). The six diseases considered are common diseases in prosthetic wearers and are a major risk factor for older patients about their survival.

An initial search was performed using PubMed[®] engine, limiting the search for papers published up to 2015. Multiple keyword combination was used: “RP,” “DW,” “HIV,” [Figure 1] “diabetes mellitus,” “diabetic, Type I and II,” “pulmonary diseases” “gastric-*H. pylori*,” “cancer,” “cardiovascular diseases,” and “pneumonia diseases.”

- RP and HIV or DW and HIV
- RP and diabetes mellitus or DW and diabetes mellitus

- RP and diabetic Type I and II or DR and diabetic Type I and II
- RP and pulmonary diseases or DW and pulmonary diseases
- RP and gastric-*H. pylori* or DW and gastric-*H. pylori*
- RP and cardiovascular diseases or DW and cardiovascular diseases
- RP and cancer or DW and cancer
- RP and Pneumonia diseases or DW and pneumonia diseases.

Another manual search was done using Embase[®] and other electronic resources. Finally, all available papers were manually refined to exclude papers not pertinent to the review topic. All types of articles were included except for editorials, case reports, and statements of personal opinion.

Inclusion criteria

- Articles written in English
- Articles were included if they met the following criteria
- Articles on studies of RD and systemic diseases.

Articles on studies of the relationship between the RD (resin denture) and (1) human immunodeficiency virus infection (HIV), (2) diabetes mellitus, diabetes type I and II, (3) “pulmonary diseases, (4) gastric-*H. pylori*, (5) cancer, (6) cardiovascular diseases, and (7) pneumonia diseases.”

In those reports, the materials investigated was the resin denture.

Exclusion criteria

Were excluded from this review:

- Clinical case reports;
- Articles written in languages other than English
- Articles on the studies of denture other than the RD
- Articles about healthy patients DWs.

Human immunodeficiency virus-infected denture wearer

Surface irregularities of acrylic resin in dentures make the entrapment of microorganisms, including *Candida* colonization

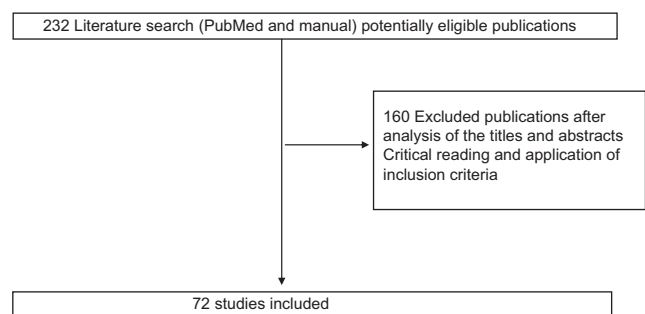


Figure 1: Selection of articles included in the review of the literature

easier. In HIV-infected patients who wear RPs, this fact takes on critical importance because of their immunosuppression.^[15] For these patients, the influence of complete or partial removable dental prostheses (RDPs) increase the frequency of *Candida albicans* isolated from the mouth. The use of RDPs was an important factor in the isolation of *C. albicans* among HIV⁺ patients, and CD4 level seems to play a role in the presence of oral candidiasis.^[16]

Diabetic denture wearer

Between the Types I and II, the prevalence of Type II diabetes (noninsulin-dependent diabetes mellitus) is the most common form of the disease concerning DW.^[17] Detected most of the time at about 40–50 years, this disease is frequent. The levels of this disease are increasing worldwide, to rise to 5.4% of the population by 2025.^[17] It can have serious consequences on the health if they are not correctly taken care, and unfortunately, since one-third of patients with diabetes are undiagnosed.^[18] Dental professionals must play an important role in diagnosing and managing patients with diabetes.^[19] Moreover, diabetes mellitus is positively correlated with edentulism.^[20] Both diabetes Type II could be one factor that increase denture stomatitis (DS)^[21] with periodontal diseases. (DS) is more common and more severe in patients with noninsulin-dependent diabetes mellitus compared to DWs with normal glucose metabolism.^[22,23]

The first microbial etiological agent of DS was the yeast *C. albicans*, but nonalbicans species were also incriminate in the disease like *Candida glabrata* has dominating as a notable pathogenic agent in the oral mucosa^[24-26] *C. glabrata* was currently find like the nonalbicans *Candida* species isolated in oral candidiasis in patients with diabetes, advanced cancer, and HIV infection.^[27,28]

The occurrence rate of oral *C. albicans* in patients with dentures (diabetic and nondiabetic patients) was higher than in patients without dentures, while *Staphylococcus spp.* was isolated more frequently from the DP of diabetic patients, compared with nondiabetic patients.^[29] In the case of Type II diabetes mellitus, there is a positive correlation between oral candidiasis in denture-bearing mucosa and elevated blood glucose levels in complete DWs. Thus, we have deduced that the elevated blood glucose induce more oral candidiasis. The oral hypoglycemic drug therapy has a positive effect in controlling oral *Candida* colonization in complete DWs.^[30] Controlling the blood glucose level in uncontrolled Type II diabetic DWs with oral hypoglycemic drugs, can reduce increased colonization of *Candida* in denture-bearing mucosa and thus enhance improved health.^[30] Therefore the role of the dentist is to educate patients in maintaining the hygiene of the prosthesis. In addition, patients should be advised of the importance of

controlling their glucose level in the blood, to regularly clean their dentures and keep them dry overnight. This precaution seems appropriate to control the *Candida* proliferation.

Cardio-vascular diseases and denture wearer

The cardiovascular diseases include both, coronary heart disease identified by subjects who reported a history of coronary artery disease or myocardial infarction, and cardiovascular risk conditions (hyperlipidemia, hypertension, diabetes, and tobacco use). No evident relationship exists between cardiovascular disease survival and RD, but the number (quantity) of remaining teeth and their maintenance (quality) and the removal of potential inflammatory foci (e.g., pericoronitis or retained root tips) may positively impact cardiovascular survival.^[31] In another study with about 400 subjects (between 29 and 70 years) with RDs, hypertension was the most common disease.^[32] Among DWs, periodontitis is a bacterial infection common in dentate individuals, and denture stomatitis is a predominantly fungal infection.^[33]

Both infections may increase a patient's risk for bacterial infection dissemination. This is may in turn increase the risk of chronic, inflammatory-based systemic diseases like atherosclerotic coronary disease^[34] stroke, and hypertension.^[35]

It appears that invasive oral pathogens trigger a systemic inflammatory response via mediators released by the cardiovascular system and liver, making the patient at increased risk for these diseases.^[36] They may be introduced into wounds created by dental manipulation or treatment, and thus may adhere to heart valves and initiate subacute bacterial endocarditis.^[37] In summary, the presence of cardiovascular disease with the DW have a life expectancy less than the partial DWs and less than dentate patients.^[31] The determining factor seems to be the hygiene and maintenance, with the recommendations of oral healthcare programs.^[31,38]

Cancer and denture wearer

The upper aerodigestive tract is an area at high risk of multiple primary cancers related inflammation.^[39,40] The occurrence rate of oral *C. albicans* in patients with dentures (cancer and noncancer patients) was higher than in patients without dentures.^[29] *C. albicans* occurs more frequently in patients taking antibiotics or immunosuppressant or patients who underwent radiotherapy and/or chemotherapy.^[41] *Staphylococcus spp.* and Gram negative enteric bacilli were isolated more often from the DP, palate and tongue dorsa of cancer patients than from patients without cancer.^[29]

In some cases, inflammatory conditions are present before a malignant change occurs, in other cases; an oncogenic change induces an inflammatory microenvironment that promotes the development of tumors.^[42,43] In all these situations, the hygienic care is recommended.^[44,45]

Pneumonia and denture wearer

Several studies show that lung infections may be related to oral bacteria^[44,46] however, they emphasize the rarity of *Candida pneumonia*. This is an area of study that would benefit from the further investigation as it is known that respiratory pathogens can colonize DP.^[47]

Denture wearing during sleep is associated not only with oral inflammation and microbial burden but also with incident pneumonia.^[48] Oral care may be useful in preventing pneumonia in older patients in nursing homes, in this way Japan study of over 400 institutionalized patients, of whom 163 were wearing dentures, daily oral hygiene and denture hygiene performed by caregivers was reported to result in reduced pneumonia, febrile illness, and death from pneumonia over 2 years of monitoring.^[49] It is important that oral management is performed by the caregivers for the prevention of pneumonia by development and maintenance of an oral hygiene program.^[50]

Poor oral health can lead to denture colonization by respiratory pathogens and serve as a reservoir for these organisms;^[47] inversely, reducing oral biofilms can reduce the risk of pneumonia in high risk populations.^[51] Optimizing oral hygiene may prevent pneumonia in vulnerable patients.^[51,52] Patients DW, with the chronic obstructive pulmonary disease, have the lower airways colonized with pathogenic bacteria in a stable period of the disease and during exacerbations. These patients showed a greater frequency of prosthetic stomatitis complicated by mucosal infections compared to healthy subjects.^[53]

Indeed, the use of an RD, in the case of mucosal inflammation, promotes superficial candidiasis.^[54] Conversely, we admit the possibility that oral microbial colonization, including prosthetic surfaces, can serve as a reservoir for swarming pulmonary circulation that is capable of penetrating the esophageal air channels. In this microbial population, commensal yeast proliferates, adheres to different receptors, develops, and promotes the installation of candidiasis.^[55]

Gastric-*Helicobacter pylori* and denture wearer inflammation

Inflammation of the oral cavity caused by bacteria or fungi can be accompanied by gastric inflammation, this particularly in the presence of denture stomatitis, hyperplasia both fibrosa, as well as papillary showed in nearly 100% gastric-*H. pylori* infection, suggesting that gastric-*H. pylori* infection affects oral mucosa at a distance, as yet, unknown mechanism.^[56]

H. pylori eradication from the oral cavity is more difficult than from the stomach, if the bacterium survives the antibacterial therapy in the oral cavity, it would be able to re-infect the stomach in a few weeks. Oral health and oral hygiene practices

seem unlikely to increase the efficacy of *H. pylori* eradication from the stomach.^[57] Contrary, long-term professional dental plaque control was associated with less gastric re-infection by *H. pylori*, suggesting that DP control may help to prevent *H. pylori*-induced gastric disease or re-infection.^[58] Although after antibiotic therapy, *H. pylori* in dental plaque may represent a risk factor for gastrointestinal re-infection and ulcer relapse.^[59]

DISCUSSION

Our choice of six systemic pathological disorders was dictated to us by the literature search. Indeed, by combining many diseases with wearing an RP we found that there are currently only a few publications on this subject. Thus, our investigation allowed us to retain the six mentioned pathologies; these are among the most common and represent a significant cause of death each year (WHO). Our aim is therefore just as for periodontal disease, to arouse the attention of health professionals on the need to take into account that wearing a removable device in patients with any of these six systemics diseases requires focus on hygiene and prosthetic followed. Many other pathologies such as malaria, asthma, are likely to be affected by association with the wearing of an RP, but did not result in any publications.

The microbiology of DP has received little attention in comparison with dental plaque, yet it differs in location and composition.^[60] DP and poor denture hygiene are associated with stomatitis (*Candida* infection), and may also serve as a reservoir of potentially infectious pathogens.

Within the oral cavity, RP are a microbial vector that may affect the delicate balance of the ecosystem of vulnerable patients^[61] [Figures 2 and 3], including patients with chronic diseases that are not considered infectious but whose pathophysiology involve microbiota (cancer, obesity, inflammation, diabetes, certain cardiovascular diseases, and neuropsychiatric disorders).^[62-66] Denture related stomatitis, a periodontal disease with respiratory^[51] and/or digestive infections^[59] are susceptible to infectious disease and need to be monitored.

The systematic screening of at-risk subjects requires an examination and history of the disease. Once identified, these patients should receive special attention.^[67]

Immunocompromised and polymedicated patients can see their quality of life affected by ingestion or aspiration of microorganisms from the prosthetic microbial plaque.^[68] Therefore, we should be vigilant and monitor the flora while controlling it long-term by appropriate hygienic means.^[69,70] Indeed biofilms, dental plaque, and DP cannot be eliminated.^[71] Only the pathogenic nature of these biofilms can be controlled

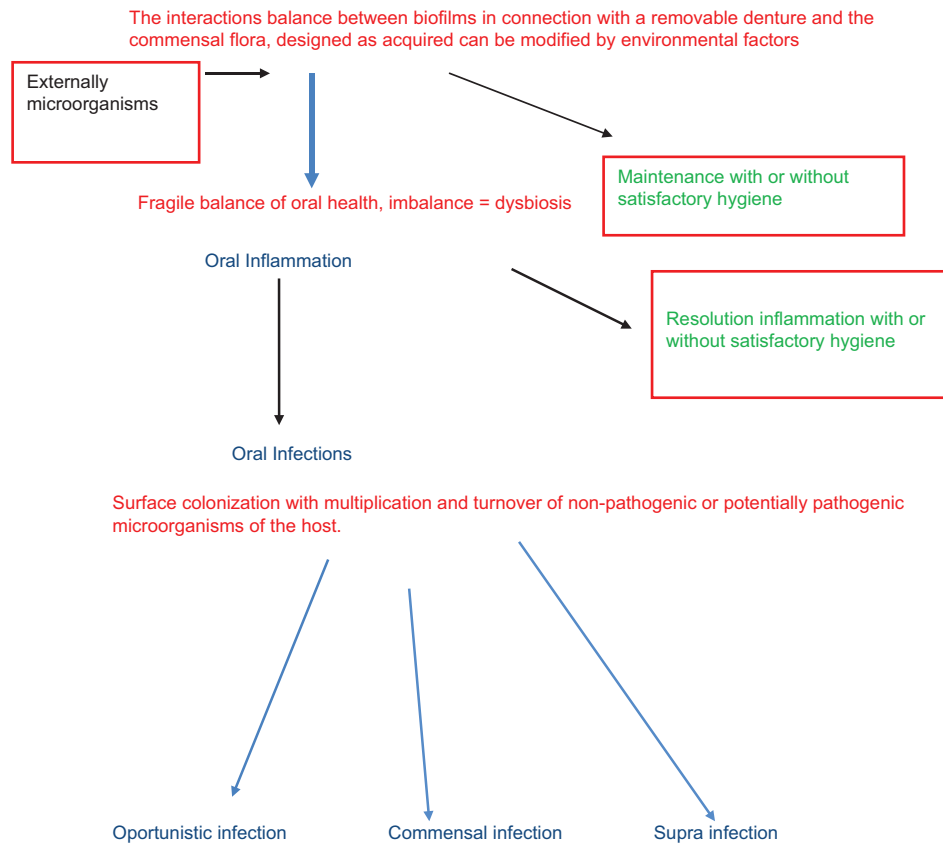


Figure 2: Schema of the influence of oral hygiene and microorganisms adhesion on removable denture

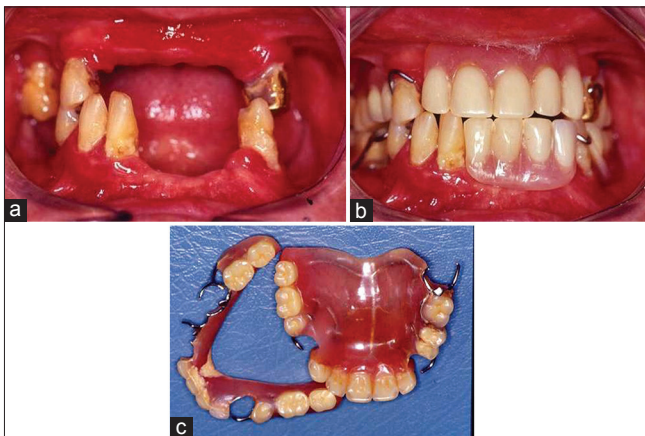


Figure 3: (a) Mouth of aging patient without hygiene, mucosal reactions (gingivitis, periodontal disease, residual ridge resorption, and caries). (b) Unsuitable removable prostheses in the mouth. (c) Removable prostheses up and down of patient

by the reduction of the total microbial load, with appropriate oral hygiene methods that include daily brushing, flossing, and rinsing with antimicrobial mouth rinses.^[71] The prevention and management of the associated sequelae, including denture disorders, justify the possible impact on specific systemic disorders.^[13]

Clinical studies have reported that disrupting the biofilm may be more important than the use of antifungal or antimicrobial agents in the prevention and treatment of denture stomatitis.^[72,73]

Preventing the formation of a biofilm on the surface of the dentures is important to maintain hygiene compatible with the balance of oral health. Surface free energy, contact angle, and surface roughness control the initial adherence of bacteria to the denture.^[71]

For preventing polishing techniques on the surface roughness of acrylic denture base resin was the most effective^[74] and resin monomer has antimicrobial effects against oral bacteria.^[75]

Basic hygiene is even more important for high risk patients as patients with xerostomia, those with a history of denture stomatitis, and those with motor disabilities, oral cancer, diabetes, immunosuppressant, and pulmonary and gastrointestinal diseases. Studies have similarly identified that removable partial dentures are susceptible to plaque accumulation,^[76] and this has been attributed to a lack of awareness of the need for good denture hygiene by patients and the lack of a regular recall system.^[77]

Many older vulnerable adults that wear dentures have oral microbial ecology determined by their diet, the latter is usually high in sugar. In these conditions, the local environment change. The interactions between the resident flora and the new arrivals, serve to promote or discourage the survival and growth of the individual species.^[78] Among the nutrient sources, carbohydrates play an important role in the pathogenesis of fungal infections.^[79,80] Dietary carbohydrates can modulate the development of *C. albicans* biofilms on the denture material surface.^[81] During the early stages of biofilm development, the presence of glucose increased metabolic activity. For the mature biofilms, starch with glucose or sucrose showed the highest metabolic activity. Finally, diet can influence the proportions of different bacterial species later in biofilm development.^[82]

CONCLUSION

The general condition of an individual throughout his or her life influences their oral ecosystem. Dentures that are initially compatible with the local and general environment can, over time, directly or indirectly cause tissue injury (inflammation, infection, ulceration, and/or hyperplasia). Two complementary therapeutic approaches exist to limit microbial accumulation in connection with RP. The first one is to limit the adhesion phenomenon on RP surfaces. The second consists of establishing and maintaining proper oral hygiene to eliminate regular deposits. We suggest better alertness in patients at-risk and maintenance particularly program in DWs. A quarterly monitoring is introduced with the reminder of the oral and prosthetic hygiene boards as well as the verification of the effectiveness of those ones.

Complications related to the use RD base resin require not only a functional but also a biological strategy (hygienic and analysis of bacterial and mycological screening) especially in at-risk patients (surveillance of immune, cardiovascular, metabolic, lung, and/or digestive diseases). Awareness of the responsibility of the oral health professional is necessary, as well as the obligation to inform patients. The health status of these patients and current literature encourage us to take all necessary measures to minimize the risk of inflammation associated with the use of RDs.

Finally, clinical studies are needed to better identification of the impact of the port of prostheses on the patient's health, especially the most vulnerable among them.

Dentures may present a putative risk of infection, especially for patients with lung and digestive diseases. It seems important to prevent this risk by means of information and patient education. Patient awareness of the nature of the risk and its

consequences should improve the control of prosthetic biofilm and reduce infection rates.

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Conflicts of interest

There are no conflicts of interest.

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