

A Clinical and Microbiological Evaluation of Denture Cleansers for Geriatric Patients in Long-Term Care Institutions

(Une évaluation clinique et microbiologique des nettoyants à prothèses dentaires chez les malades gériatriques des établissements de soins de longue durée)

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S o m m a i r e

Contexte : De nombreux malades gériatriques dans les établissements de soins de longue durée ne peuvent pas brosser leurs prothèses dentaires de manière adéquate parce qu'ils sont malades, sont atteints de démence et manquent de dextérité. Un tel nettoyage inadéquat peut entraîner la multiplication de *Candida spp* et des bactéries, qui pourraient servir de réservoir d'infections.

Objectif : Évaluer l'efficacité de 3 nettoyants à prothèses dentaires dans la réduction du nombre de microorganismes sur les prothèses dentaires de la population hospitalière gériatrique.

Méthodologie : Nous avons comparé 3 marques de nettoyants (*Denture Brite*, *Polident* et *Efferdent*; nous avons utilisé de l'eau pour le groupe témoin). Nous avons prélevé des échantillons biologiques avant et après une semaine d'utilisation des nettoyants. Ces échantillons ont été prélevés à l'aveugle par un microbiologiste. Dans l'analyse statistique, nous avons utilisé le modèle linéaire général pour comparer les différences de rangs entre les résultats avant traitement et après traitement de chaque schéma. De plus, nous avons évalué l'efficacité de chaque nettoyant dans la réduction de l'accumulation de la plaque dentaire, des taches et de la nourriture.

Résultats : Les différences de rangs dans les cellules souches myéloïdes multipotentes (CFU) de *Candida spp* avant et après une semaine d'utilisation de *Denture Brite* ($p = 0,04$) et *Polident* ($p = 0,01$) était nettement plus élevées que celui du groupe témoin, mais il n'y avait pas de différence entre le groupe ayant utilisé *Efferdent* et le groupe témoin ($p = 0,10$). Nous n'avons pas observé de réduction notable des *Streptococcus mutans* entre les groupes ayant utilisé *Denture Brite* ($p = 0,13$) ou *Polident* ($p = 0,12$) et le groupe témoin, tandis que les prothèses dentaires nettoyées avec *Efferdent* affichaient une réduction nettement plus élevée des *Streptococcus mutans* ($p = 0,02$) que les prothèses dentaires nettoyées avec de l'eau. Tout au long de la durée de l'étude, nous n'avons pas enregistré de différences notables entre les nettoyants en ce qui concerne la réduction de *Candida spp* ou de *Streptococcus mutans*. Les prothèses dentaires nettoyées avec *Denture Brite*, *Polident* ou *Efferdent* affichaient le même niveau de réduction de la plaque dentaire, des taches et de la nourriture, et toutes affichaient des niveaux de réduction nettement plus élevés que les prothèses dentaires nettoyées seulement avec de l'eau. La différence considérable de la réduction du *Candida spp* CFU ($p = 0,005$) était sujette à la variance entre les durées de l'étude ($p = 0,01$) et à la variance entre les sujets ($p = 0,008$).

Importance clinique : L'utilisation de nettoyants à prothèses dentaires a considérablement réduit le nombre de microorganismes sur les prothèses dentaires dans la population hospitalière gériatrique.

Mots clés MeSH : dental plaque/prevention and control; denture cleansers/therapeutic use; denture, complete/microbiology

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It is common knowledge that edentulous patients in long-term care hospitals cannot adequately brush or maintain their dentures because of disease, dementia and poor dexterity.¹⁻⁴ Studies have revealed that poor dental hygiene and *Candida albicans* infections are common among elderly denture wearers.^{3,5} As well, nurses in institutions are already overburdened, which makes it difficult for them to care for their patients' dentures. Regardless of cleaning efforts by patients and staff, soft debris, bacterial plaque and dental calculus are often found on denture surfaces.^{1,6}

The importance of clean dentures in such patients should not be underestimated. Dentures containing debris, tartar and stain cause irritation and subsequent tissue response. Food particles located between the denture and the gingiva or between the denture and the palate allow multiplication of *Candida* spp. and bacteria, which can cause denture stomatitis¹ and multiple papillomatosis of the palate.³ These microorganisms may also serve as reservoirs for disseminated infections with gastrointestinal and pleuropulmonary involvement^{7,8}; however, it was recently noted that periodontal disease did not significantly increase the risk of coronary artery disease.⁹ *Candida* pneumonia has been reported in a non-immunosuppressed host.¹⁰ Fungal or bacterial infections may cause subacute bacterial endocarditis in patients with artificial heart valves and pneumonia in patients with chronic obstructive pulmonary disease.¹¹

Denture cleaning and plaque elimination are generally neglected in most long-term care institutions. Patients and their family members, management staff and nursing staff exhibited a lack of understanding of the oral hygiene needs of geriatric patients, especially those who wear dentures.⁶ Information provided by the American Dental Hygienists' Association on the care and cleaning of dentures recognized the value of commercially prepared denture powder, paste or tablets.¹² Brushing alone is insufficient for controlling plaque on dentures.¹³ It is thus extremely important that chemical denture cleansers be used as an adjunct for patients unable to properly care for their dentures and manage overall oral hygiene.¹⁴

Immersion-type chemical solutions for cleaning dentures may be divided into 2 major groups: denture cleansers and disinfectants. Commercial denture cleansers may be classified into the following groups according to their mode of action or their main component: alkaline hypochlorites, alkaline peroxides, neutral peroxides with enzymes, enzymes, acids, crude drugs, and mouth rinses or oral rinses for dentures.¹⁵

A literature review revealed few clinical studies, especially those targeting the hospitalized geriatric population. The efficacy of some cleansers has been tested in the laboratory, but the results of laboratory studies do not necessarily agree with experience in vivo.¹⁶

It was the purpose of this study to determine the effectiveness of the cleansers Denture Brite, Polident Overnight and Efferdent New Concentrated Blue Tablet in reducing *Candida* spp. and bacteria on denture surfaces as well as in dislodging

food and reducing plaque and stain in a geriatric population living in a long-term care institution.

Material and Methods

Study Population

This randomized crossover study was approved by the Research and Ethics Committees of the Sir Mortimer B. Davis Jewish General Hospital (SMBD JGH) and the Jewish Nursing Home (JNH), Montreal, Quebec.

Subjects were eligible if they were edentulous and had a complete acrylic upper denture. Subjects with partial dentures or lower dentures only and those who had used a denture cleanser within the previous 2 weeks were not eligible. Subjects were selected by one dental hygienist (I.P.) between January and May 2000 from the residents of the long-term care facilities of the SMBD JGH and the JNH.

Thirty-seven patients were invited to participate in this study. Of these, 2 were unable to participate because of their emotional state, 3 refused and 5 of those who accepted were discharged after randomization but before the data were collected. For the remaining 27 patients, 14 men and 13 women, mean age was 84 (standard deviation 8.8) years.

Clinical Examination

After signing the consent form, each subject underwent a complete oral examination; all examinations were performed by a single dentist.

Randomization and Blinding

Subjects were assigned at random to 1 of 4 groups, independent of any other factors (e.g., sex); each study group received 1 of the 3 denture cleansers or water (control).

Two dental hygienists (I.P. and A.M.M.) were responsible for the treatment protocol. The patients, the microbiologist responsible for the cultures and the dentists involved in the evaluation of the dentures were blinded as to treatment group.

Treatment Protocol

Three commercial denture cleansers were used in this study. Denture Brite (Advantage Products, Langley, British Columbia) is an oxygen producer that contains potassium peroxymonosulfate, potassium bisulfate, potassium sulfate and potassium peroxybisulfate; its pH is 1.8. Polident Overnight (GlaxoSmithKline Consumer Health Group, Oakville, Ontario) and Efferdent New Concentrated Blue Tablet (Pfizer Consumer Health Care, Scarborough, Ontario) are carbon dioxide producers that contain citric acid, sodium bicarbonate and potassium monosulfate (pH 7.0 and 7.5, respectively).

For all patients, water only was used to clean dentures for an initial one-week period before the study began. Then, the assigned cleanser or water (control) was used to clean dentures in the first week. In the crossover design, the other cleansers were used for 1-week periods separated by a 1-week wash-out (during which water only was used). The wash-out periods were intended to allow *Candida* spp. and bacteria to repopulate the dentures and to eliminate the effects of the previous cleanser.¹

Efficacy of Cleansers

The rank of the differences in numbers of CFUs of *Candida* spp. before and after the use of Denture Brite ($p = 0.04$) and Polident ($p = 0.01$) for the first study period were significantly greater than the control group (Table 2); however, there was no significant difference between Efferdent and control ($p = 0.10$). No significant differences in reduction of *Streptococcus mutans* were observed between Denture Brite ($p = 0.13$) or Polident ($p = 0.12$) and the control group, whereas dentures cleaned with Efferdent had significant reduction of *Streptococcus mutans* ($p = 0.02$) (Table 2).

There was substantial variance among the 3 cleanser groups in the number of CFUs of *Candida* spp. and *Streptococcus mutans* at the end of the various study periods. In a multivariate analysis encompassing all study periods, there was a significant difference in the rank of the number of CFUs of *Candida* spp. ($F = 2.53$; $p = 0.005$). Dentures treated with Denture Brite appeared to have significantly greater reduction in the number of *Candida* spp. than those treated with Efferdent ($p = 0.06$). No differences were observed between Denture Brite and Polident ($p = 0.25$) or between Polident and Efferdent ($p = 0.43$) (Table 3).

In addition, the difference in the rank of the number of CFUs of *Candida* spp. was associated with the variance between study periods ($F = 4.76$; $p = 0.01$) and with the variance between subjects ($F = 2.25$; $p = 0.008$), and not to the treatment sequence ($F = 1.34$; $p = 0.27$).

There was no significant difference in number of CFUs of *Streptococcus mutans* between cleansers (Table 4). Additionally, no significant difference was noted among individuals ($F = 1.34$; $p = 0.22$), treatment groups ($F = 0.38$; $p = 0.69$), study periods ($F = 0.31$; $p = 0.74$) or treatment sequence ($F = 0.37$, $p = 0.69$).

Efficacy in Dislodging Food and in Reducing Plaque and Stain

The mean differences in the visual analogue score for accumulation of plaque, stain and food over one treatment period (day 1 to 7) for dentures treated with Denture Brite, Polident or Efferdent were significantly different from those for dentures in the control group. There were no differences between cleansers in this respect (Table 5).

Discussion

During the first study period (days 1 to 7), the cleansers had different levels of effectiveness in reducing the 2 main types of microorganisms. Denture Brite and Polident were more effective than water in reducing *Candida*

spp. In contrast, the reduction in the number of *Streptococcus mutans* was significantly greater with Efferdent than with water (Table 2). The use of cleanser significantly reduced the amount of plaque, stain and food on the dentures (Table 5).

The significant difference between cleansers in rank of reduction in *Candida* spp. was not related to the treatment used but to the variability in the number of CFUs of *Candida* spp. between the 3 study periods and between subjects (Table 3). The effects of a cleanser in vivo are constantly challenged by the daily ingestion of food, which may explain at least part of the variability between study period and subjects.

The large variability in the number of microorganisms may explain the discrepancies in results between various studies. In another study, involving 15 patients wearing complete maxillary and mandibular dentures, Efferdent was a little more effective than Polident in reducing plaque but less effective than other cleansers (Mersene and Clorox-Calgon).²⁰ McCabe and others¹⁷ did not find significant differences between cleansers in the reduction of calculus.

Table 1 Baseline characteristics of 27 elderly patients in long-term care institutions

Characteristic	Treatment group			
	Denture Brite (n = 7)	Polident (n = 7)	Efferdent (n = 7)	Control (water) (n = 6)
Mean age (years) ^a	79.2	83.6	84.0	80.0
No. of males ^a	4	4	4	2
No. with stomatitis ^a	4	4	4	2

^aNo significant difference between any cleanser and control ($p > 0.05$)

Table 2 Mean difference^a and rank of mean difference in number of colony-forming units (CFUs) of *Candida* spp. and *Streptococcus mutans* over the first study period (days 1–7)

Treatment group	<i>Candida</i> spp.		<i>Streptococcus mutans</i>	
	Mean difference (SD)	Rank of mean difference (SD)	Mean difference (SD)	Rank of mean difference (SD)
Denture Brite	285,017.8 (301,608.3)	51.3 ^b (17.2)	244,083.3 (691,133.9)	41.7 (30.0)
Polident	560,040.3 (624,715.1)	58.4 ^b (17.9)	21,528.6 (37,257.7)	42.0 (11.9)
Efferdent	237,408.9 (948,334.4)	43.6 (31.4)	348,545.0 (517,007.3)	51.4 ^b (30.3)
Control (water)	-35,991.7 (140,008.9)	22.5 (21.4)	-557,382.5 (1,223,408.4)	19.6 (19.4)

SD = standard deviation

^aNumber of CFUs at baseline minus number of CFUs on day 8; positive values represent a reduction and negative values an increase in the number of CFUs relative to baseline

^bSignificant difference between cleanser and control ($p < 0.05$)

Table 3 Mean difference^a and rank of the mean difference in number of colony-forming units (CFUs) of *Candida* spp.

Treatment group	Study period 1 (days 1–7)		Study period 2 (days 15–21)		Study period 3 (days 29–35)	
	Mean difference (SD)	Rank of mean difference (SD)	Mean difference (SD)	Rank of mean difference (SD)	Mean difference (SD)	Rank of mean difference (SD)
Denture Brite	285,017.8 (301,608.3)	51.3 (17.2)	91,775.2 (130,014.6)	36.8 (19.6)	2,581.6 (51,239.1)	29.3 (12.9)
Polident	560,040.3 (624,715.1)	58.4 (17.90)	155,547.1 (231,866.2)	43.1 (17.9)	489,047.1 (1,162,486.6)	42.7 (21.0)
Efferdent	237,408.9 (948,334.4)	43.6 (31.4)	566,514.5 (562,780.2)	52.1 (28.0)	32,915.5 (56,366.6)	32.6 (14.0)

SD = standard deviation

^aNumber of CFUs at baseline minus number of CFUs on day 8; greater values represent a greater reduction in the number of CFUs relative to baseline

Table 4 Mean difference^a and rank of the mean difference in number of colony-forming units (CFUs) of *Streptococcus mutans*

Treatment group ^b	Study period 1 (days 1–7)		Study period 2 (days 15–21)		Study period 3 (days 29–35)	
	Mean difference (SD)	Rank of mean difference (SD)	Mean difference (SD)	Rank of mean difference (SD)	Mean difference (SD)	Rank of mean difference (SD)
Denture Brite	244,083.3 (691,133.9)	41.7 (30.0)	42,583.3 (71,024.2)	42.2 (20.3)	-57,636.0 (259,344.5)	34.8 (27.8)
Polident	21,528.6 (37,257.7)	42.0 (11.9)	279,660.0 (666,992.8)	47.1 (19.9)	77,531.4 (123,293.3)	46.4 (19.9)
Efferdent	348,545.0 (517,007.3)	51.4 (30.3)	16,644.9 (30,956.3)	32.2 (19.2)	204,133.3 (410,329.3)	49.3 (21.1)

SD = standard deviation

^aNumber of CFUs at baseline minus number of CFUs on day 8; positive values represent a reduction and negative numbers an increase in the number of CFUs relative to baseline

^bThere were no significant differences among cleansers ($p > 0.05$)

The validity of the results of this study relate to methodology. Two trained hygienists, following the same protocol to decrease bias among groups, applied the treatments. Individual patients were not informed about the study hypotheses, and the microbiologist who cultured swab samples was blinded to treatment. Another advantage was the long wash-out period (7 days) between treatment periods to allow accumulation of *Candida* spp. and bacteria. Furthermore, the most accurate method of examining microbial plaque was applied in this study.¹⁶ Finally, the very good agreement among the 3 dentists in terms of scores related to plaque, stain and food, in spite of obvious interoperator subjectivity, contributed to the validity of our results.

However, this study had some limitations. The subjects were selected in 2 locations, which might limit the generalizability of the results. In addition, even though most of the patients had physical limitations that would have prevented them from cleaning their own dentures, it was not possible to verify whether they did so. Another constraint was that the

presence of microbes was evaluated at only one specific position on the denture. It has recently been suggested that it is preferable to identify microorganisms in denture plaque from the whole surface of the denture.¹⁶ The unspecified types of *Candida* spp. also represent a limitation. The difficulty in distinguishing between plaque, stain and food debris on the photographs should also be considered a potential limitation.²¹ Finally, the small sample size in this study limited the power of the analyses and constrained the interpretation of our results.

The significant reduction in the number of microorganisms, plaque, stain and food observed in this study suggests that the use of denture cleansers is a suitable method for cleaning dentures in the geriatric hospitalized population. This conclusion is supported by the finding of Chan and others¹⁴ that brushing alone with a denture abrasive was less effective than cleanser use for maintaining good denture hygiene. Those authors suggested that cleanser use may be particularly appropriate for elderly people who lack manual dexterity.¹⁴ Of

Table 5 Mean difference^a and rank of mean difference in accumulation of plaque, stain and food over the first study period (days 1–7)

Treatment group	Mean difference (and rank of mean difference) ^b		
	Plaque	Stain	Food
Denture Brite	16.9 (33.8)	16.2 (27.0)	20.1 (34.1)
Polident	14.1 (29.7)	25.6 (36.5)	18.1 (31.3)
Efferdent	13.9 (31.3)	21.6 (34.2)	19.0 (30.3)
Control (water)	62.3 (66.3)	61.0 (61.7)	65.8 (65.2)

^aRating at baseline minus rating on day 8 (mean of assessments by 3 dentists); lower values represent a reduction in ranking relative to baseline

^bFor each variable (plaque, stain and food), there was a significant difference between each cleanser and the control group ($p > 0.0001$) but no significant differences between the cleansers

concern was the increase in the number of microorganisms observed when dentures were soaked in water. Further studies are needed to determine if daily use of a cleanser can reduce the high prevalence of denture stomatitis in such patients (52% in this study group) or if it might cause mucosal irritation and allergy.²² ➤

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