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Denture disinfection by microwave irradiation: A randomized clinical study

Daniela Garcia Ribeiro [a], *Ana Cláudia Pavarina* [a,*], *Lívia Nordi Dovigo* [a], *Denise Madalena Palomari Spolidorio* [b], *Eunice Teresinha Giampaolo* [a], *Carlos Eduardo Vergani* [a]

[a] *R. Humaitá n° 1680, CEP 14801-903, Department of Dental Materials and Prosthodontics, São Paulo State University, UNESP, Araraquara Dental School, Araraquara, São Paulo, Brazil*

[b] *R. Humaitá n° 1680, CEP 14801-903, Department of Physiology and Pathology, São Paulo State University, UNESP, Araraquara Dental School, Araraquara, São Paulo, Brazil*

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ABSTRACT

Objective: This study evaluated the clinical effectiveness of two exposure times of microwave irradiation on the disinfection of complete dentures.

Methods: Biofilm samples were collected from dentures of 30 patients, who were randomly divided into two experimental groups of 15 subjects each: Group 1—patients had their maxillary denture microwaved for 3 min (650 W); Group 2—patients had their maxillary denture microwaved for 2 min (650 W). Denture biofilm samples were taken with swabs, before (left side surfaces) and after (right side surfaces) microwave irradiation. All microbial material was plated on selective media for *Candida* spp., *Staphylococcus* spp., mutans streptococci and a non-selective media. After incubation (48 h/37 °C), the number of colony-forming units (cfu/mL) was counted. Microorganisms which grew on selective media were identified using biochemical methods. The data were statistically analyzed by Kruskal–Wallis test, followed by Dunn's post-test ($\alpha = 0.05$).

Results: Microwave irradiation for 3 min (Group 1) resulted in sterilization of all dentures evaluated. After microwave irradiation for 2 min (Group 2), a significant decrease in *Candida* spp. ($P = 0.0062$), *Staphylococcus* spp. ($P = 0.0178$), mutans streptococci ($P = 0.0047$) and non-identified species ($P < 0.0001$) was achieved in comparison with the cfu/mL obtained before irradiation. The colonies grown after 2 min of microwave irradiation were identified as *Candida albicans*, non-aureus *Staphylococci* and *Streptococcus mutans*.

Conclusion: Microwave irradiation for 3 min may be a potential treatment to prevent cross-contamination.

1. Introduction

One of the main issues involved in wearing dental prostheses is the roughness of acrylic material, which promotes plaque formation on denture surfaces and the likelihood of microorganisms accumulating.[1] Denture plaque consists of a structured community of microorganisms surrounded by a self-produced polymeric matrix and adherent to an inert or living surface.[2] These complex biofilms have particular functions to avoid their detachment from the surface and

* *Corresponding author at:* Faculdade de Odontologia de Araraquara - UNESP, R. Humaitá n° 1680, CEP 14801-903, Araraquara, São Paulo, Brazil. Tel.: +55 016 33016410; fax: +55 016 33016406.
E-mail address: pavarina@foar.unesp.br (A.C. Pavarina).

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protect them from host defence mechanisms. Studies[3,4] have demonstrated that different species of oral and non-oral pathogens are associated with denture plaque, including *Candida* spp., *Staphylococcus* spp., *Streptococcus* spp., *Lactobacillus* spp., *Pseudomonas* spp., *Enterobacter* spp. and *Actinomyces* spp. These microorganisms are frequently related to local diseases[5] such as caries, periodontal disorders and mucosa inflammation, and systemic infections such as urinary tract infections, conjunctivitis, pneumonia and meningitis.[4]

The microorganisms adhered to the denture surface create a potential source of contamination from patients to dental and laboratory personnel. Powell et al.[6] observed that 67% of all materials sent from dental offices to the dental laboratories were infected with opportunistic pathogens. Thus, to reduce the chances of cross-contamination in the dental environment, dentures should be completely disinfected before being sent to the laboratory and before insertion. Some chemical agents have been proposed to reduce microbial contamination of prostheses.[7,8] However, denture-soaking solutions can cause deleterious effects on acrylic resins.[9,10]

Since the disinfection method should be effective without having any detrimental effect on acrylic denture materials, a major research effort has been focused on alternative methods for prostheses decontamination. Microwaving dentures have been suggested as a simple, inexpensive and effective method of disinfection.[11–15] Rohrer and Bulard[13] reported that complete dentures contaminated with individual suspensions of aerobic bacteria and fungi were sterilized after 10 min of microwave irradiation (720 W). It was also demonstrated that microwave irradiation at 350 W for 6 min was a more effective method of inactivating microorganisms on dentures than soaking in sodium hypochlorite.[14] Buergers et al.[16] showed that microwave irradiation (6 min/800 W) significantly decreased *Candida albicans* colonization in soft denture relining specimens. A preliminary study[17] verified that acrylic resin specimens colonized with *C. albicans*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Bacillus subtilis* were sterilized after 6 min of microwave irradiation at 650 W. Another investigation[18] also observed that 6 min at 650 W was sufficient to inactivate *C. albicans* and *Staphylococcus aureus* obtained from simulated complete dentures. Furthermore, microwave irradiation (6 min/650 W) of complete maxillary dentures was effective for the treatment of *Candida*-related denture stomatitis.[19] Although 6 min of microwaving at 650 W has proved to be an effective method for acrylic resin sterilization[17,18] and for the treatment of denture stomatitis,[19] it has been observed that this practice decreased the flexural strength of a hard chairside reline resin[20] and the surface hardness of 5 brands of acrylic resin denture teeth.[21] Moreover, Seo et al.[22] verified that thermal and mechanical stress exerted deleterious effects on the strength of intact and/or relined denture bases after 6 min of microwave irradiation (650 W).

Therefore, several studies[11,14,23,24] have been developed to evaluate microwave exposure times shorter than 6 min. Sterilization of wet acrylic resin specimens inoculated with individual suspensions of four microorganisms (*C. albicans*, *P. aeruginosa*, *Staphylococcus aureus* and *B. subtilis*) was achieved after 3, 4 and 5 min at 650 W of microwave irradiation.[23] Ribeiro et al.[24] demonstrated that the flexural strength and hardness of different acrylic resin specimens were not detrimentally affected by irradiation with microwaves for 1, 2, 3, 4 or 5 min in a wet condition. However, there is a lack of reports in the literature, which evaluated the effectiveness of these microwave irradiation times for the clinical disinfection of complete dentures immersed in water.

Thus, this clinical study tested the hypothesis that complete maxillary dentures worn by patients could be sterilized by microwave irradiation to avoid cross-contamination.

2. Materials and methods

2.1. Patient selection

A total of 30 patients, maxillary complete denture wearers aged between 45 and 80 years, who were attended at the Araraquara Dental School - UNESP, were included in the present study. The patients were invited to participate in the survey by telephone. The subjects were healthy people and their dentures had been in use for at least 6 months. Furthermore, one of the inclusion criteria was that the volunteers had not, or were not soaking dentures in a disinfectant solution. All the patients received verbal oral hygiene instructions. The examiners wore gloves, protective clothing, masks and eye protection during all clinical and laboratory procedures. After attending each patient and performing microbial culture, the operator's gloves were discarded and replaced with sterile gloves. The protocol (26/2005) of each treatment was reviewed by the Ethics Committee of the Araraquara Dental School – São Paulo State University and each patient provided written consent to participate in this study.

2.2. Experimental groups

The patients ($n = 30$) were randomly assigned to one of two experimental groups (Group 1 and Group 2) of 15 subjects each. Blind investigators were responsible for clinical procedures, such as: first denture collection, microwave irradiation and second denture collection. Microbiological procedures were carried out by one investigator. A first collection of biological material (control) of each denture ($n = 30$) was made before microwave exposure. Control samples were collected from the left half of all denture surfaces, which were vigorously rubbed for 1 min with a sterile cotton swab. Denture biofilm samples were placed in tubes containing 4.5 mL of sterile saline solution. After that, each maxillary denture was individually transferred to a 600 mL beaker containing 200 mL of sterile distilled water. Each beaker was placed on the rotational plate in a domestic microwave oven (Model Sensor Crisp 38, Brastemp, Doublé Emission System, Manaus, AM, Brazil) and irradiated once for 3 min (Group 1) or 2 min (Group 2) at 650 W. Following the same procedure as above, a second collection of biological material from each denture ($n = 30$) was made after microwave irradiation.

2.3. Microbiological examination

The saline tubes obtained before and after microwave irradiation were vortexed for 1 min to disperse microorganism