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Original Research

Effect of Microwave Energy on Fungal Growth of Resilient Denture Liner Material

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ABSTRACT

Introduction: Contamination of resilient denture liner material with microorganisms, particularly Candida albicans, is a common clinical problem. Denture hygiene is essential to maintain the serviceability of the denture, and microwave has been suggested for denture disinfection. **Aim**: The aim of this study was to determine the effectivenes of microwave energy in the disinfection of a resilient denture liner contaminated with C. albicans. **Material and methods:** A resilient denture liner material was contaminated with Candida albicans and reduction of organism counts after test disinfection methods (microwave energy, soaking overnight in a dilute sodium hypochlorite and alkaline peroxide solutions) calculated. **Results:** In this study the effectiveness of microwave energy in the disinfection of resilient denture liners was determined. A one-way ANOVA test indicated that there was a significant difference between the groups. **Conclusion:** Disinfection of Vertex Soft resilient denture liner material in sodium hypochlorite solution proved a more effective method than exposure to microwave energy. Because sodium hypochlorite solution presents some disadvantages in clinical use, microwave energy disinfection can be considered an effective and simple alternative.

Keywords: disinfection, resilient denture liner, microwave energy, candida albicans.

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INTRODUCTION

Resilient denture liner materials are applied to the intaglio surface of dentures to achieve a more equal force distribution, to reduce localized pressure and to improve denture retention by engaging undercuts (1). Ideal denture cleansers should be easy to use, bactericidal and fungicidal, nontoxic, harmless to the structure of dentures, and effective at removal of organic and inorganic deposits (2). There are several problems associated with the use of resilient denture liners including, bond failure between the liner and denture base, colonization by Candida albicans, porosity, poor tear strength, and loss of softness (3). Effective denture plaque control is indispensable for clinical use of those materials, because bacterial and yeast plaque is a major factor in the etiology of denture stomatitis (4). Inadequate cleaning by the patient leads to microbial growth on liner surface and denture stomatitis. Inadequate cleaning could also contribute to deterioration of desirable liner properties (5). Denture

hygiene is esential to maintain the service ability of the denture because of esthetic concerns and for prevention of denture-related stomatitis. Because the most effective preventive and curative treatment for pathogens is believed and curative treatment for pathogenes is believed to be adequate denture hygiene, denture cleansers have been studied to identify the ideal product (6). Mechanical cleansing has been shown to be an effective means of providing denture cleanliness and achieving a healthy mucosa beneath the dentures. Recently, the use of microwave energy to disinfect dentures has been suggested to overcome the problems associated with denture cleaning. Several authors (11) have demonsrated the efficacy of microwave energy in this context. Rohler and Bulard (12) introduced microwave energy for sterilization of nonautoclavable dental materials. Incontrast to other authors, demosrated that 10 minutes of microwave exposure at high power could cause dimentional changes in the denture (13). However, the suggested that 6 minutes microwave energy at a medium setting is sufficient for disinfection while maintaining dimentional stability. The aim of this study was to determine the effectivenes of microwave energy in the disinfection of a resilient denture liner contaminated with C. albicans.

MATERIALS AND METHODS

The materials used are listed in Table 1. Ten specimens with a cross-sectional area of 2×2 cm were prepared for each group using Vertex Soft resilient denture liner material. For Vertex Soft polymerization, the powder-liquid ratio used was 2:1 and the material was mixed for 60 seconds. Then, the fl asks were placed under pressure in a standard fl ask press (No.01001; Teledyne Hanau, Buffalo, NY) for 15 minutes, and immersed in a water bath for 3 hours at 70˚C, followed by 30 min at 100˚C. The fl ask was left to cool for 20 minutes at room temperature before being cooled in cold running tap water for 10 minutes and the cured Vertex Soft resilent denture liner material defl asked. Three test groups disinfection methods were as follows; subjected to microwave energy disinfection at 650 W for 5 minutes, specimens soaked in sodium hypochlorite (dilute solution of stabilized 2% wt/vol sodium hypochlorite, diluted 1:150 giving 125 ppm available chlorine) and alkaline peroxide solutions overnight. A reference C. albicans was used to investigate the efficacy of disinfection. Microorganisms were subcultured onto blood agar plates and incubated overnight at 37ºC. The principle of the experiment was to contaminate sterile specimens of Vertex Soft resilient denture liner material with known microorganisms and to determine any reduction in count of viable adherent cells after one of three test disinfection methods.

TABLE 1

Trade name	Chemistry	Manufacturer
Vertex Soft	Heat-cured, acrylic-based	Dentimex, Zeist Hoolond
Milton	Sodium hypochlorite	Procter& Gamble Health & Beauty Ltd., Surrey, UK
Steradent	Alkaline peroxide	Reckitt&Colman.,Inc., Jull, UK
Todd Hewitt	Broth culture	Oxoid Unipath Ltd, Basingstoke, UK

The reduction in viable, adherent cells was calculated by comparison with appropriate control specimens, but without a disinfection method. Vertex Soft resilient denture liner material specimens were autoclaved (15 minutes, 121ºC) to ensure that the specimens were sterile. Sterile specimens were placed into sterile universal bottles containing 10 mls broth inoculated with 2 to 3 drops of overnight broth culture of the test microorganism. After inoculation, bottles were placed on a rotary turntable to gently invert the bottles at regular intervals thus avoiding sedimentation of cells. Incubation was aerobic at 37ºC, with broth changes (15 mls) after 24 hours and 48 hours. After 3 days total incubation, broth was discarded and specimens washed by adding 2×10 mls of phosphate buffered saline (PBS) with gentle rocking to remove non adherent cells. Excess PBS solutions were drained from the specimens. At this stage, the test disinfection regime was carried out for each test group. For first treatment (microwaving), Vertex Soft resilient denture liner material specimens were placed into a sterile dish and then exposed to microwave irradiation in the 650 W microwave oven for 2.5 minutes per side. For second treatment (alkaline peroxide), 15 mls Steradent solution transferred to ten sterile universal bottles. One piece of Vertex Soft resilient denture liner material was then placed into each glass bottle and left for 5 hours at room temperature. For third treatment (sodium hypochloride), Milton sterilizing solution was prepared by adding 1.3 mls Milton to 200 mls distilled water and 15 mls aliquots of the solution transferred to ten sterile universal bottles. One piece of Vertex Soft resilient denture liner material was then placed into each glass bottle and left for 5 hours at room temperature. After the test methods, all Vertex Soft resilient denture liner materials were placed individually into 10 mls PBS solution in sterile glass bottles. Glass beads were agitated in the bottles for 1.5 minutes. Dilutions were performed by transferring 1 mls of the resulting suspensions into 9 mls fresh PBS and this process was repeated in 10-fold dilution to 10-3. Drop counting was performed on blood agar plates using 20 µl aliquots.

Blood agar plates were then incubated overnight at 37ºC in a carbon dioxide incubator. Colonies were counted, and the number of colony forming units per square millimeter (cfu/mm2) resilient denture liner sample were calculated. One-way ANOVA and the Tukey HSD post-hoc tests were used to assess the different treatment methods effectiveness on the disinfection of resilient denture liner material. All statistical testing was performed at a pre-set alpha level of 0.05. Results and Discussion Mean and standard deviations of the number of colony forming units per square millimeter are given in Table 2. The number of colony forming units per square millimeter for each group ranged from 0 to 1.1384. The significant overall difference was detected by one-way ANOVA. Tukey HSD test was performed to show difference between individual groups. Soaking the resilient denture liner in sodium hypochlorite solution for 5 hours was found to be extremely effective in destroying C. albicans. Microwave energy was more effective than soaking in alkaline peroxide solution.

TABLE 2

Means and standard deviations of cfu/mm^2

Disinfection methods	Mean	±SD
Microwave energy	0.123	0.03
Soaking alkaline peroxide	1.72	0.31
Soaking hypochlorite solution	0	0

A one-way ANOVA indicated that there was a significant difference between the groups. In this study the effectiveness of microwave energy in the disinfection of resilient denture liners was determined. Gradual changes in oral tissues require complete or partial dentures to be relined to improve their adaptation to the supporting tissue. Although maintenance of appropriate denture hygiene is important, many denture wearers fail to maintain a satisfactory level of hygiene. Therefore a wide range of chemical denture cleansers are available to facilitate denture hygiene. These solutions not only control plaque on dentures but may also cause significant deterioration of resilient liners as well. Both sodium hypochlorite and microwave energy produced a large reduction of cell counts with the reduction for sodium hypochlorite slightly greater than the reduction with microwave energy. Sodium hypochlorite solution is sometimes discredited because of the bleaching effect, denture corrosion, and odor (9). However, other studies claimed that no deterioration of resilient denture liner materials occur when hypochlorite denture cleansers are used (14,15). and presented evidence of this solution as an effective antifungal agent when used as a denture soak in cases of denture-related stomatitis (16).

There are two major problems with the use of a sodium hypochlorite soak to disinfect dentures. One is the length of time for which the denture must be out of the mouth and the other is the effect of sodium hypochlorite on metal. Although Rudd et al. (13) suggested that full-strength bleach can kill microorganisms when used only 5 minutes, the effect of this treatment on the dentures was examined on the visually to determine any deterioration in color and surface details. Microscopic examination might reveal changes in the denture surface. Microwave disinfection is effective and quick, which may be a significant advantage for some patients. When considering practical plaque control on resilient lining materials, the choice of denture cleanser depends on many factors including composition and expected time of service. Because these chemical solutions can cause significant deterioration on resilient liners, the compatibility between materials should be considered to avoid or minimize alteration of properties. Disinfection of Vertex Soft resilient denture liner material in sodium hypochlorite solution proved a more effective method than exposure to microwave energy. Because sodium hypochlorite solution presents some disadvantages in clinical use, microwave energy disinfection can be considered an effective and simple alternative.

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