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Acrylic resin disinfection by peracetic acid and microwave energy

Avaliação da efetividade do ácido peracético e da irradiação por microondas na desinfecção de resina acrílica

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ABSTRACT

Objective
The objective of this study was to evaluate the effectiveness of disinfection methods in microwave and immersion in peracetic acid in heat-cured, self-cured and microwave-cured acrylic resin, contaminated with Candida albicans.

Methods
Five specimens were prepared for each type of acrylic resin. All were infected with Candida Albicans, incubated at 37°C for 24 hours. The group which underwent microwave energy was irradiated with a power of 840W for 1 minute and the other group underwent disinfection by soaking of 0.2% peracetic acid for 5 minutes.

Results
All samples proved to be contaminated after the incubation period. After the different processes of disinfection, both immersion in 0.2% peracetic acid as microwave irradiation were effective in disinfection of the 3 types of acrylic resins contaminated by Candida Albicans.

Conclusion
Concluded that soaking in 0,2% peracetic acid for 5 minutes with microwave irradiation power 840W for 1 minute are effective methods for disinfecting heat-cured acrylic resin, self-cured acrylic resin and microwave-cured acrylic resin, contaminated with Candida Albicans.

Indexing terms: *Acrylic resins. Microwaves. Peracetic acid.*

RESUMO

Objetivo
Avaliar a eficácia dos métodos de desinfecção em microondas e imersão em ácido peracético em resina acrílica termopolimerizável, autopolimerizável e resina acrílica polimerizada por microondas, contaminadas com Candida albicans.

Métodos
Cinco amostras foram preparadas para cada tipo de resina acrílica. Todas foram infectadas com Candida Albicans, incubadas a 37 ° C durante 24 h. O grupo submetido a energia de microondas foi irradiada com uma potência de 840W durante 1 minuto e o outro grupo foi submetido a desinfecção por imersão de ácido peracético a 0,2% durante 5 minutos.

Resultados
Todas as amostras mostraram estar contaminadas depois do período de incubação. Depois dos diferentes processos de desinfecção, tanto a imersão em 0,2% de ácido peracético, como a irradiação de microondas foram eficazes na desinfecção dos 3 tipos de resinas acrílicas contaminados por Candida Albicans.

Conclusão
Concluiu-se que a imersão em ácido peracético 0,2% durante 5 minutos e a irradiação de microondas com potência de 840W durante 1 minuto são métodos eficazes para a desinfecção de resina acrílica termopolimerizável, resina acrílica autopolimerizável e resina acrílica polimerizada por microondas, contaminados com Candida Albicans.

Termos de indexação: Resinas acrílicas. Micro-ondas. Ácido peracético.

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INTRODUCTION

The increase in the number of elderly in the world, the increasing prevalence of tooth loss, dry mouth, and the use of dental prostheses are some factors associated with increased incidence of infections *Candida* Albicans[1-2]. Candida albicans fungi are able to adhere to the surface of prostheses and form biofilms. High surface roughness, surface energy difference between the fungus and the substrate and the presence of salivary films are factors influencing adherence of this microorganism acrylic resin[3]. The presence of biofilm of this fungus in dental prosthetics can lead to erythematous candidiasis, most common manifestation of *candida* infection[4].

Oral hygiene and denture cleaning are factors contributing to the longevity of the prosthesis. The use of chemicals associated with the mechanical toilet brush shapes are recommended cleaning and prevention of infections[1]. chemical agents such as hypochlorite 1% and 2% glutaraldehyde are widely recommended disinfecting prosthesis, although not ideal for this purpose because hypochlorite can interfere the aesthetics of the prosthesis, the glutaraldehyde and can be irritating and allergy causing be toxic. Peracetic acid has been highly recommended and used in the food industry and also to disinfect hospital equipment because it does not release harmful by-products[5]. Microwave energy has been recommended as an effective method for disinfecting complete dentures and as an adjuvant for the treatment of stomatitis[4,6]. Suggested protocols for disinfection by microwave irradiation has showed effective at different times and potential[7]. Microwave irradiation for a time of 1 minute exposure was shown to be effective for disinfection against Candida albicans[8].

The objective of this study was to evaluate the effectiveness of disinfection methods in microwave and immersion in peracetic acid in heat-cured, self-cured and microwave-cured acrylic resin, contaminated with *Candida albicans*.

METHODS

Specimens production

Were used three types of acrylic resin, the all of VIPI DENTAL LTDA São Paulo Brasil brand: heat-cured acrylic resin (VIPI CRIL®), self-cured acrylic resin (VIPI FLASH®) and microwave-cured acrylic resin (VIPI WAVE®). Fifteen specimens of each type resin, totaling 45 specimens, were fabricated with dimensions of 10.0 x 10.0 x 3.0 mm (length x width x thickness). The manipulation was done at a ratio of 2: 1, two measures powder for liquid measurement.

To obtain the rectangular specimens, a stainless steel matrix of dimensions 10.0 x 10.0 was used x 3.0 mm (± 5 mm). The arrays were included in plaster type II (ordinary gypsum) into the muffle. After complete crystallization of the gypsum (± 2 hours) the resin was inserted in the muffle. After the addition of the resin, and against the muffle furnace was closed and pressed together with a load of 500 kg, immediately after being once opened for removal of excess. Then, it was pressed with a load of 1000 kg and after 30 minutes was initiated polymerization process.

For the microwave-cured acrylic resin, the polymerization was performed with 20 minute cycle at 140 W potency, followed by a further 5 minutes at 420 W potency. For heat-cured acrylic resin, the polymerization was conducted in a 70°C bath water for 90 minutes, followed by a further 60 minutes at a temperature of 100°C.

To obtain the self-cured acrylic resin specimens, the material has undergone all the above procedures except that have not been put in oven and were not pressed, because the material is polymerized at room temperature, for 60 minutes.

After the polymerization process the muffle was brought to a workbench for its cooling for four hours. After this time, each specimen was removed from the oven and was given finishing and polishing. The Finishing was done with electric motor to remove the excess. The wear was made with milling cutters and mounted on an aluminum oxide stone. Then they were polished with sandpaper water nº. 280-400 - 600 - 1000. After these procedures, the samples were measured in caliper, with rectangular dimensions of 10.0 x 10.0 x 3.0 mm.

The polishe was done in polisher machine using abrasive material such as pumice and white of Spain, in order to shine and smoothness to the surface of the specimen.

Microbiological analysis

They were divided into 3 groups, each with five specimens for each resin, totaling 15 specimens in each group. The samples were contaminated with a known strain of the fungus *Candida albicans* obtained from the American Type Culture Collection (ATCC 10231) in test tube containing a solution of 10^{-2} ml of *C. Albicans*, incubated at 37°C for 24 hours. After contamination, the

samples used as controls were washed in sterile distilled water for 5 minutes and immersed in BHI broth (Brain Heart Infusion) without undergoing decontamination. The group of specimens receiving microwave irradiation as a method of decontamination, were irradiation for 1 minute microwave power 840W and immersed in BHI. The samples of group decontaminated with peracetic acid were immersed in peracetic acid 0,2% w / w for 5 minutes and immersed in BHI.

Microbiological analysis was to check the growth of *C. albicans*. The fungus growth evaluation was performed by observing the turbidity of the broth, and the appearance of the specimen surface through Zeis lens with 40x magnification, and performing Gram stain, after the incubation period.

RESULTS

Microbiological analysis showed that contamination occurred after the initial incubation period, in all the specimens, regardless of the type of resin, leaving the surface of specimens opaque, the BHI broth containing turbid.

After the disinfection process, the group that received Peracetic acid as the group receiving microwave disinfection show to be effective. The surface of the specimens showed up with a high degree of transparency and the BHI broth showed up clear. (no turbidity)

DISCUSSION

This study assessed the effectiveness of the methods of disinfection by irradiation with a microwave power of 840W for 1 minute immersion in 0,2% peracetic acid for 5 minutes on heat-cured acrylic resin, self-cured acrylic resin and microwave-cured acrylic resin. It is expected that these methods are effective for the disinfection of acrylic resin articles contaminated with *Candida Albicans.*

This microorganism is commonly found in the oral cavity and has its importance in the process of cross-infection. Dentures are considered as predisposing factors to increase the number of these microorganisms in the oral cavity[1], since it can adhere to the surface of the prosthesis and form biofilms[3-4,9]. The presence of Candida albicans in biofilm is the main factor in the etiology of stomatitis related to the prosthesis, an infection commonly found in denture patients[10]. By coming into contact with the oral cavity of the patient, articles made of acrylic resin are considered semi-critical and must therefore be subjected to disinfection procedures. However, should not undergo any disinfection procedure involving high temperatures, being thermosensitive[5].

The disinfection process is the use products capable of promoting the reduction or elimination of microorganisms, in addition to the mechanical method performed with toothbrushes. The peracetic acid is a strong disinfectant, due to its antimicrobial efficacy as well as being non-toxic[1,11]. It is an alternative for disinfection of heat-sensitive items such as acrylic resin, besides being effective, safe and not be inactivated in the presence of organic matter. Chassot et al.[5] demonstrated the effectiveness of disinfection of 3 types of acrylic resin in 0.2% peracetic acid for 5 minutes, meeting of this study. 2% peracetic acid was compared with sodium hypochlorite at 1% for 30 and 60 minutes, showing no significant difference between the chemical disinfection independent of the dip time[12]. In addition to the peracetic acid, the microwave disinfection also has its proven antimicrobial activity[13].

The microwave disinfection was performed at a power of 840W for 1 minutes. The exposure time and power may vary depending on the size of this biofilm on the prosthesis cover. Greater plaque coverage required more time of exposure to radiation. Senna et al.[8] in their study showed that for a smaller amount of biofilm attached prosthesis, a power of 900W for 1 minutes it was able to disinfect. However, when a power of 450W was tested disinfection occurred after 2 minutes. The same power 450W was also only effective for *Candida albicans* after 3 minutes of irradiation, one when it reached 71°C temperature, and after 2 minutes there was a reduction in the number of viable cells associated with mechanical cleaning of the prosthesis[14]. The same time of 3 minutes at a 650W power also showed satisfactory results for disinfection of acrylic resin articles[15]. At that time and power when compared to other components used for disinfection such as chlorhexidine, showed to be equally effective[16].

CONCLUSIONS

Based on this study it is concluded that soaking in 0,2% peracetic acid for 5 minutes with microwave irradiation power 840W for 1 minute are effective methods for disinfecting heat-cured acrylic resin, self-cured acrylic resin and microwave-cured acrylic resin, contaminated with *Candida Albicans*.

Collaborators

CBB FORTES, study design, acquisition of data, drafting of manuscript, critical revision. VCB LEITUNE, study conception and design, analysis and interpretation of data, critical revision. FM COLLARES, study conception and design, analysis and interpretation of data, critical revision. NB DORNELLES JUNIOR, acquisition of data, drafting of manuscript. SB RODRIGUES, acquisition of data, contributed substantially to discussion. SW SAMUEL, contributed substantially to discussion, critical revision. CL PETZHOLD, study conception and design, critical revision. V STEFANI, study conception and design, critical revision.

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