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Comparative evaluation of the effect of various denture cleansers on microorganisms over heat polymerized acrylic resin

[1]Dr. Benita P., MDS, FICOI (USA), Prosthodontist and Oral Implantologist, Chennai, India

[2]Dr. Balamurugan. R, MDS,Oral and Maxillofacial Surgeon, Chennai, India

Corresponding Author: Dr. Balamurugan R., MDS, Oral and Maxillofacial Surgeon M RYA COSMO Foundation Hospital, Chennai, India

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Abstract

Purpose: The purpose of this study was to measure the anti-microbiological effect of four different denture cleansers both on polished and non-polished surface of heat polymerized acrylic resins.

Materials and methods: Test samples were fabricated. Staphylococcus Epidermidis was grown on nutrient agar overnight and colonies were suspended in normal saline with turbidity matching 0.5 Mc Farland standard. The sterile artificial saliva was taken in sterile disposal plastic containers, to this 0.5ml of bacterial suspension was added and sterilized in autoclave and placed in the containers containing artificial saliva. This preparation was kept in the incubator at 37°C overnight. Each group is placed in 4 different sterile containers. From each slab the samples were collected using sterile moistened swab from one surface and plated on nutrient agar. After this the acrylic swabs were placed in the disinfectant overnight. The second swabs were collected and inoculated on nutrient agar. The agar plates were incubated at 37 °C overnight anaerobically and colony count was made.

Results: The samples were evaluated after 24 hours and macroscopic estimation of the growth of micro-organisms were observed as the number of colonies formed (CFU). No statistical significant differences were obtained between groups.

Conclusion: The results of our study conclude that the antimicrobial effect of different denture cleansers on heat cure denture base resins were similar between the groups.

Introduction

Oral care is important for the prevention of caries, periodontal disease and many systemic diseases. Also denture care is indispensable for general health of not only elderly, fragile and immune compromised patients but also for healthy patients [1]. Surface roughness of dentures influence the adherence of microorganisms [2,3]. Willams et al [4] have also reported that surface roughness favours the microbial colonization. Bacteria on the surface of the denture can cause fatal infections such as pneumonia and endocarditis due to poor hygiene. Hence, denture care especially in the elderly becomes vital.

The denture cleansing systems should be safe to both tissues and fabricated material, relatively inexpensive, involve minimal physical effort and must be capable of removing plaque not only from polished surface of the prosthesis, but more importantly from unpolished surfaces. Various methods have been reported in prosthodontic literature for cleaning dentures. These have been broadly classified as having mechanical and

chemical effects. The former group includes abrasive pastes used in association with brushes and ultrasonic cleaners. Effective plaque removal requires a degree of manual dexterity that is often lacking among geriatric, physically handicapped, mentally retarded and non-motivated patients. In such situations use of chemical denture cleansers can be more advantageous. Dentures can be cleaned mechanically, chemically or by their combination.

Denture cleaning pastes with their active ingredients and/or tooth pastes are commonly used in the mechanical method. The abrasive, detergent, humectant and flavouring properties of the pastes provide potential effects for removing the debris from the denture surface. Chemical cleansers contain a variety of active agents. Effective disinfection can be attained by enzymes, hypochlorite solutions, acids, mouth washes and peroxide solutions [5]. The sodium hypochlorite-based denture cleansers are fungicidal and are known to be effective by dissolving mucin and other organic substances [6]. Sodium hypochlorite does not change the roughness, but can deteriorate the base material by bleaching and corrosion [6]. Alkaline peroxides are the most commonly used denture cleaners [7,8].

Besides their chemical effects, they can remove stains mechanically by releasing oxygen. Alkaline peroxides present good antimicrobial activity against denture biofilms in the absence of odour and after taste [9]. Glutaraldehyde based solutions have also proved to be potent antimicrobial agents, and are often used in dentistry. They are not inactivated when in contact with organic materials, are not corrosive, and do not degrade rubber or plastic materials [10].

However the researchers are still ambiguous about the toxicity of glutraldehyde, thus its usage is considered to be limited. Several disinfectants have been suggested for denture cleaning. The current expectation for cleaning agents is to clean simply and effectively, with no risk to human health, and with no adverse effects on the properties of the denture material. In light of these observations, this study investigated the efficiency of different denture cleaning agents against microorganisms formed on polished and non-polished surfaces of denture base materials.

Materials and Methods

Preparation of acrylic slabs

Test samples were fabricated in the following method. A casting wax sheet with tissue topography simulated on one surface was used. The thickness of the sheet was adjusted to 3 mm. These sheets were cut into smaller squares of 1 × 1 cm squares. These were invested using Type III dental stone to have good reproduction of the tissue surface. The heat polymerising denture base material was packed in the flask and excess removed following a trial closure under a hydraulic bench press. Then the flasks were secured in a dental clamp and polymerized in an acrylizer.

Preparation of bacterial suspension:

Staphylococcus Epidermidis was grown on nutrient agar overnight and colonies were suspended in normal saline with turbidity matching 0.5 Mc Farland standard.

Contaminating acrylic slab:

The sterile artificial saliva was taken in sterile disposal plastic containers, to this 0.5ml of bacterial suspension was added and sterilized in autoclave and placed in the containers containing artificial saliva. This preparation was kept in the incubator at 37°C overnight. This is to allow the bacteria to form a bio film. After incubation the 40 slabs were taken and rinsed in sterile normal saline and divided into four groups with 10 slabs in each group.

Groups

Group I – Heat polymerized acrylic resin immersed in sodium perborate (2ml in 100ml water dilution)

Group II – Heat polymerized acrylic resin immersed in chlorhexidine (2ml in 100ml water dilution)

Group III – Heat polymerized acrylic resin immersed in clove oil (2ml in 100ml water dilution)

Group IV – Heat polymerized acrylic resin immersed in Eucalyptus oil (2ml in 100ml water dilution)

Each group is placed in 4 different sterile containers. From each slab the samples were collected using sterile moistened swab from one surface and plated on nutrient agar. After this the acrylic swabs were placed in the disinfectant overnight. The second swabs were collected and inoculated on nutrient agar. The agar plates were incubated at 37 °C overnight anaerobically and colony count was made.

Results

The samples were evaluated after 24 hours and macroscopic estimation of the growth of micro-organisms were observed as the number of colonies formed (CFU). The observations were analysed with ANOVA test using SPSS software. The results of our study showed a statistical insignificance of P>0.05 between groups (Table 1).

Groups	Mean	Standard Deviation	P Value
Sodium	0.60	0.34	0.974
Perborate	0.40	0.89	0.742
Chlorhexidine	0.40	0.54	0.674
Clove oil	0.60	0.89	0.925
Eucalyptus			

Table 1: ANOVA test of significance

Discussion

Poor oral hygiene is not only associated with periodontitis but also with systemic diseases such as aspiration pneumonia, cardiovascular diseases and diabetes [1]. Especially in the elderly, existence of oral microorganism may become a potential indicator for high risks of certain diseases. Mechanical cleaning like brushing is inexpensive and effective. However, some patients have restricted hand control especially because of their elderness. Chemical method merely requires soaking the denture into the solution only. Some researchers have found that mechanical cleaning is better than chemical cleaning [5,11,12]. However, chemical disinfectants have some advantages over mechanical cleaning such as effectivity and ease of use especially for elderly individuals [9]. This was the primary reason of choosing commonly used chemical cleaners.

There is abundant documented evidence showing the relationship between good oral health and denture cleanliness. A significant relationship between poor denture cleanliness and denture stomatitis was first described by Jorgenson et al [13]. According to Jorgenson [13] this infection can be best prevented by meticulous oral and denture hygiene. There are various methods of cleaning dentures and there are different reports with conflicting results. Among the cleansing agents used in the present study (Sodium perborate, Chlorhexidine, Clove oil and Eucalyptus oil) is known to be bacteriostatic at their respective concentrations.

Studies have reported the antimicrobial activity of plants and seeds used as raw materials for manufacturing soaking solutions. These products are relatively safer synthetic alternatives and offer significant and more affordable therapeutic benefits. The most routinely followed method for cleaning the dentures were overnight soaking in any commercially available denture cleansing solutions. Most proprietary immersion cleansers can be divided into alkaline peroxides (percarbonate or perborate), alkaline hypochlorites, dilute organic or inorganic acids, and enzymes. Moreover, the immersion method for cleaning dentures is beneficial because it is easy and can be employed as an auxiliary method along with brushing.

In this study heat polymerized acrylic resin was chosen. Besides its low porosity incidence and ease of manipulation, acrylic resin was used as an appropriate material for evaluating the effect of disinfectants on the surface. Microbial assessment was based on both polished and non-polished surfaces of heat polymerized denture base resin. Polished specimens simulated the outer surface, while non-polished specimens simulated the inner surface of the acrylic base resin. In this study we evaluated the association between microorganism adhesion and surface polishing. The adherence and colonization of microorganism may change by ongoing usage and cleaning cycle. Since continuous application of disinfectants may alter the surface characteristics [8], hence only one cycle of usage and cleaning was assessed in this study. Staph. Epidermidis microorganism was tested both on polished and non-polished surfaces so as to compare the efficiency of chemical cleaners in our study. Many studies have investigated the effect of chemical cleaners on microorganisms, but most of them have only focused on the adhesion and cleaning methods of C. albicans [2,6,9,14-17].

According to the present results, the disinfectant solutions reduced microbial contamination independently from colony numbers (1-9 or ≥10) on both polished and non-polished heat polymerized acrylic resin, but none of them were able to destroy all the microorganisms.

Conclusion

According to the present results, the disinfectant solutions reduced microbial contamination independently from colony numbers (1-9 or ≥10) on both polished and non-polished heat polymerized acrylic resin, but none of them were able to destroy all the microorganisms. Our study conclude that the antimicrobial effect of different denture cleansers on heat cure denture base resins were similar between the groups.

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