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Review Article

Antimicrobial efficacy of commercially available of denture cleansers on heat polymerized acrylic resins: A review of literature

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ABSTRACT:
One of the commonest ailments prevalent among these population groups is partial or complete edentulousness. Hence the dentist /speciality dentist plays a significant role in executing the rehabilitation procedure. Esthetic considerations aside, the layer of plaque which forms on the tissue-fitting surface of the denture is probably of greatest clinical significance. A variety of soft tissue changes are associated with complete or removable partial dentures. Hence; the present review was undertaken for summarizing antimicrobial efficacy of commercially available of denture cleansers on heat polymerized acrylic resins.
Key words: Denture, cleansers

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INTRODUCTION

As the world is ageing care extended to geriatric population has to be thoughtfully planned and implemented. One of the commonest ailments prevalent among these population groups is partial or complete edentulousness. Hence the dentist /speciality dentist plays a significant role in executing the rehabilitation procedure. In addition to this, the dental practitoner or the specialist dentist has to chart out a review and maintenance protocol for the rehabilitated patients to prevent any post treatment complications or sequelae.[1]

The process by which dentures accumulate plaque, stain, and calculus is apparently similar to that process which takes place on natural teeth.' MacCallum et al.' have characterized the calcareous deposits which form on dentures as consisting essentially of an inorganic and an organic portion. The organic portion (15% to 30% of total deposit) is basically glycoprotein and is responsible for binding the deposit to the denture. It is presumed that these glycoproteins are similar in nature to the organic matrix of plaque on natural teeth. Dental plaque has been strongly implicated in the etiology of several conditions which lead to esthetic concerns.[2]

Esthetic considerations aside, the layer of plaque which forms on the tissue-fitting surface of the denture is probably of greatest clinical significance. A variety of soft tissue changes are associated with complete or removable partial dentures. These changes manifest themselves as a series of related symptom complexes which include denture stomatitis ("denture sore mouth"), inflammatory papillary hyperplasia, and chronic candidiasis. Ill-fitting dentures, trauma, and lack of denture cleanliness are the most commonly cited triad of local etiologic factors for each of these entities. It has been suggested that the presence of denture plaque constitutes the

principal cause leading to the inflammation of the palatal mucosa.[3]

It is a known fact, that the dentures that are cared for on a daily basis heighten patient's sense of wellbeing by keeping the tissues in the mouth healthy and free from unfavorable changes. In spite of the increase in dental awareness in patients, many leave the dental office totally uninformed on how to care for their complete dentures. Though mechanical cleansing using a soft denture brush and water is the most recommended as well as effective and safe method to clean dentures, for persistent accumulations or stains, overnight immersion in denture cleansers is a common practice. A number of patients learn to clean their dentures from news, media and advertisements which can prove to be detrimental to the overall health of the uninformed patient. Therefore a dentist must posses a thorough knowledge of the various types of cleansers, their mode of action, ingredients, their effect on dentures as well as their potential to cause allergic reactions.[4]

Denture care products should be able to remove inorganic/organic deposits and stains, be easy to handle, have bactericidal and fungicidal properties, present no toxicity to patients, be compatible with denture materials and have a low cost. However; these requirements are difficult to achieve in a clinical setting. Denture hygiene methods can be classified as mechanical or chemical. Brushing is the most widespread mechanical method with the advantage of being simple, inexpensive, and effective. However; patients with low dexterity may found it difficult to perform and there is a possibility of acrylic resin wear and superficial damage to relining materials. Chemical denture cleansers are able to dislodge food debris, biofilm, and tobacco stains from prosthodontic surfaces effectively.[4- 8]

CLASSIFICATION OF DENTURE CLEANSERS

Denture cleansers correspond to a variety of products designed to safely remove stains, deposits, and debris from the surfaces of dental prostheses, by means of various methods. Denture cleansers can be classified as

According To Type

Creams, pastes, gels and solutions or even tablets that are made to clean dentures. Soaking dentures in the cleaning solution varies from a few minutes to overnight depending on the manufacturer's instructions where as denture cleansing creams, pastes or gels are brushed on the denture after it is removed from the mouth and then rinsed off.

According to the mode of action

The most commonly used cleansers are represented by the group of alkaline peroxides

Oxidizing (bleaching) agents

Alkaline perborate, sodium perborate or postassium monopersulfate. These compounds remove staining and kill the bacteria harbored on a denture's surface

Reducing Solutions

Sodium hypochlorite

Effervescing agents

Perborate, carbonate or citric acid. Effervescing agents provide for the rapid disintegration of the product and also create a mechanical cleansing action.

Chelating agents

EDTA. This type of compound helps to remove the tartar that has accumulated on a denture's surface.

Detergents

Sodium polyphosphate. These compounds assist in cleansing the denture.

Additional compounds

Dye markers that provides a color change when the cleansing process has been completed.

Enzymes

Protease, amylase

Disinfectants

Potassium permanganate, gluteraldehyde[4]

LITERATURE

Tripathi P, Phukela SS, Yadav B, Malhotra P (2018) evaluated and compared the surface roughness in heat-cured denture-based resin and injection-molded resin system as affected by two commercially available denture cleansers for a period of 15, 30, and 45 days. A standardized metal die was fabricated to make 120 denture-based resin discs of uniform dimensions. The samples of heat-cured denture-based resin and injection-molded thermoplastic denture-based resin were immersed in the two denture cleansing solutions for a period of 15, 30, and 45 days, respectively. The surface roughness was evaluated by surface profilometer TR200. The data were subjected to statistical analysis and the comparison of quantitative data was done using unpaired t-test and repeated-measures ANOVA test. The surface roughness values (Ra) of heat cured denture base resin samples when immersed in two denture cleansers were 0.22 μm at 0 days, 0.27 and 0.29 μm at 15 days, 0.29 and 0.31 μm at 30 days, 0.30 and 0.31 μm at 45 days whereas for injection moulded samples surface roughness values were 1.31 & 1.27 μm at 0 days, 1.46 & 1.66 μm at 15 days, 1.50 & 1.69 μm at 30 days, and 1.50 & 1.69 μm at 45 days. They concluded that the surface roughness (Ra) increased significantly in injection-molded polyamide denture-based resin samples when immersed in both the denture cleansers. Whereas, heat-cured denture-based resin samples did not reveal any significant surface changes at the various time intervals.[7]

Hayran Y, Sarikaya I, Aydin A, Tekin YH (2018) assessed the effect of three denture materials against Candida albicans biofilm and to determine effective concentrations of denture cleanser tablets. The surface-roughness of Acron-hi™, QC-20™ and Deflex™ resins was standardized by using a profilometer and their contact angle or surface free energy was calculated. C. albicans biofilm was formed on all three resins and were treated with

Polident 3 min™, Corega™ and Fittydent™ cleanser solutions at various concentrations and both resin-biofilm and cleanser-biofilm interest were determined by using a MTT protocol according to the European Committee on Antimicrobial Susceptibility Testing's antifungal susceptibility testing (AFST-EUCAST). Scanning electron microscopy was used to compare the efficacy of different resin materials against C. albicans biofilm. Anticandidal activity and surface free energy statistical parameters were calculated by using 3-way and 1-way ANOVA, respectively. Polident 3 min™ and Corega™ tablets significantly inhibited the proliferation of C. albicans against all denture resins at 27-37 mg/mL. Scanning electron microscopy results indicated that there was no significant difference among resin specimens regarding biofilm formation on dentures. They failed to find a significant relationship between surface free energy and the anticandidal effect of resin types. However, the polarity value of the resins was statistically associated with their anticandidal activity. The polarity of the resins, the concentrations of tablets and the chemical content of the cleanser may directly affect C. albicans biofilm formations. Polident 3 min™ and Corega™ tablets should be suggested for patients who use any denture resin types, whereas the Fittydent™ tablet should only be proposed for those who use Deflex™, when two tablets are dropped into 150 mL water.[8]

Chatzivasileiou K, Kotsiomiti E, Vyzantiadis TA (2019) examined the effectiveness of a small sample of commercial denture cleansers in removing Candida albicans cells from denture surfaces. A total of 216 specimens from three brands of denture base resins (72 for each acrylic resin) were divided into three groups of 24 specimens that each received a different surface treatment (Ra1, Ra2, and Ra3). The specimens were contaminated by the Candida albicans strain ATCC 90028, immersed for 15 minutes in one of two experimental denture cleanser solutions or in tap water, and placed in Petri dishes with culture medium. Candida albicans colonies were measured after 24-hour incubation at 37ÆC. There was a statistically significant difference in the cleansing result depending on the denture cleanser used. The use of commercial denture cleansers may under certain conditions be effective in the removal of Candida albicans from denture bases.[9]

Namala BB, Hegde V (2019) evaluated and compared the effect of plant extract (thyme essential oil solution) and commercially available denture cleanser on the flexural strength and surface roughness of denture base resin. Chemical denture cleansers play a vital role in maintaining the hygiene and serviceability of the dentures. Bacterial resistance to these chemical agents paved way to plant-extracts as novel denture cleansing agents. However, the effect of these plant-extract denture cleansers on the physical and surface characteristics of denture base resins has not been evaluated. A total of 90 heat polymerizing denture base material (Trevalon, Dentsply) samples were fabricated and divided into 3 groups with 30 samples each. Samples from each group were immersed in their respective denture cleanser solution (Group A- Distilled water(control); Group B- Fittydent denture cleanser; Group C- Thyme essential oil solution denture cleanser) for a simulated overnight 8hr immersion for 180 days. The samples were evaluated for increase in surface roughness and flexural strength using Tally-surf Surface Profiler and Instron Universal Testing Machine respectively. Results obtained were statistically analyzed using one-way ANOVA. Thyme essential oil solution group showed minimal increase in surface roughness (ΔRa) with values comparable to that of the control group which had the least increase in surface roughness and Fittydent group showed significant increase in surface roughness. For flexural strength, statistically significant difference was observed among the three groups with Fittydent group showing the highest flexural strength followed by control group and Thyme essential oil solution group. However, the decrease in the flexural strength was not of clinical significance. They concluded that plant extract - thyme essential oil denture cleanser was superior in preserving the surface roughness of denture base resins compared to commercially available denture cleanser. Clinically significant difference in flexural strength was not observed between the denture cleanser groups.[10]

de Almeida MAL, Batista AUD, de Araújo MRC, et al (2020) investigated the efficacy of cinnamaldehyde for the disinfection of complete removable dentures, and the effect on the physical and mechanical properties (Vickers microhardness, color, and surface roughness) of the acrylic resin. Acrylic resin disks were inserted into the dentures of a probabilistic sample of 33 complete denture users, that used cinnamaldehyde (27 μg/mL) and 0.5% sodium hypochlorite solutions in a 20 min/7-days protocol of dentures immersion in each solution, with a wash-out period of 7 days, to constitute a crossover-study. The disks were analyzed before and after the immersion, for the presence of microorganisms (CFU/mL) and by scanning electron microscope (SEM). Also, the surface roughness (Ra) and Vickers microhardness were measured, and color parameters were analyzed using the National Bureau of Standards (NBS) method. Data was analyzed by Wilcoxon and Friedman (microbiological evaluation), paired t-test (color and roughness) and independent t-test (Vickers hardness). A significant reduction in the number of microorganisms was observed for each species, with no significant differences between hypochlorite and cinnamaldehyde. There was an increase in the roughness and a decrease in the hardness of the test specimens, with no difference between the two disinfectant substances. Both hypochlorite and cinnamaldehyde also caused changes in color, considered as “perceptible” by the NBS classification,

but with no significant difference between disinfectant substances, and under the clinically acceptable limit. The 27 μg/mL cinnamaldehyde solution was effective against all evaluated microorganisms and caused minor alterations in hardness, surface roughness, and color parameters, with no clinical relevance.[11]

Zidan S, Silikas N, Haider J, Yates J (2020) assessed the colour stability of high-impact heat-polymerized denture base acrylic resin (HI PMMA) impregnated with zirconia nanoparticles after storage in distilled water (DW) and denture cleaners such as Steradent (STD) and Milton (MIL) for 180 days. Ninety specimens of PMMA + Zirconia nanocomposite with varying nanoparticle concentrations (1.5 wt.%, 3.0 wt.%, 5.0 wt.%, 7.0 wt.% and 10 wt.%) were prepared with a diameter and thickness of 25 ± 1.0 mm × 2 ± 0.1 mm and divided into six groups, while each group was further divided into three subgroups: storage in DW (control), STD and MIL. Colour changes were measured with a Minolta Chroma Meter (Minolta, Osaka, Japan), and assessed using the CIE L*a*b* colorimetric system. Data were statistically analysed for colour change with Friedman's Two-way and Kruskal-Wallis tests at a pre-set alpha value level of 0.05. The colour change (ΔE) exhibiting significant differences were found among all groups immersed in denture cleaners, and all values increased with time. According to the National Bureau of Standards, the control group displayed the lowest colour change value (ΔE = 1.22), and the highest value was for 10 wt.% ZrO2 while stored in MIL (ΔE = 6.07). The values of colour change for storage in water ranged from 0.49 (control) to 1.82 (10 wt.% ZrO2). The colour change value for the composite group containing 3 wt.% zirconia was clinically acceptable. However, high concentrations of denture cleaners should be avoided, and the shortest cleaning time is recommended to improve the clinical life of the nanocomposite denture base.[12]

Gad MM, Fouda SM (2020) reviewed the antifungal effects of the different methods that have been suggested for the prevention and/or control of DS as well as the antimicrobial activity of denture base acrylic resin additives, including nanoparticles. Studies reporting the incorporation of antifungal/antimicrobial agents into the polymethyl methacrylate (PMMA) denture base were included in this review. The PubMed, Web of Science, Google Scholar, and Scopus databases were searched for the articles published between January 2000 and December 2018 using the following key words: dental prosthesis, denture stomatitis, candidiasis, antifungal agents, biofilm formation, polymethyl methacrylate, and PMMA. The antimicrobial material incorporated into the resin may have a superior effect in preventing DS over simply coating the surface of the denture base. However, some antimicrobial fillers can have adverse effects on the physical and mechanical properties of the denture base resin.[13]

DISCUSSION

Over the last three decades, developments in dentistry have largely been instigated as a result of scientific research. Of particular note, are developments in the field of dental materials and a drive toward the practice of evidence-based dentistry. Many aspects of prosthodontics treatment; be it clinical or laboratory based, have an impact on overall patient satisfaction and the clinical success of treatment.

Prosthesis is provided to replace the lost part and also to restore the lost or impaired functions due to missing part or organ of the body. To make it more meaningful, the care and maintenance of the prosthesis is of paramount importance including maintaining hygienic condition. Oral cavity is a site where a diverse, complex, and abundant microbial community exists. This diverse flora is seen in edentulous patients who wear complete dentures. Dentures enhance the accumulation of food debris and formation of denture plaques, both of which can initiate a condition called as denture stomatitis.

Inadequate home care can seriously compromise the clinical results of even the most meticulous denture prosthesis fabricated utilizing excellent material and techniques. When denture has been stained or having tartar deposits, that resort to plain chemical or physical methods of cleaning with proprietary cleaners. Denture cleansers are either chemical or abrasive in their mode of action.[14, 15]

Three methods are advocated for cleaning of dentures that includes mechanical, chemical and combination of both. Mechanical method is routinely and widely used by the patients but many elderly patients are not able to follow it because of lack of compliance and poor motor coordination due to age and hence, the use of chemical denture cleansers becomes a viable option for such patients. Denture cleansers are either available commercially as sodium hypochlorite solutions, denture cleansing tablets (fittydent tablets) or are present as a regular household item like vinegar. Ideally, cleanser chosen should be compatible with the denture base material to be disinfected.[14]

According to a study by Veres et al, 60–90% of patients with dentures use mechanical cleaning in association with products such as toothpaste, soap, or water. An inappropriate cleaning method involves the use of a toothbrush and toothpaste to remove large particles, which may affect the texture of the denture material and also result in the formation of plaque or the inhibition of plaque removal. By contrast, soaking in disinfectant solutions with chemical agents was shown to be an effective procedure to decrease the number of contaminating organisms, although some chemical agents used for denture cleaning are known to damage acrylic resin and metal alloy materials. Recent scientific developments indicated that microwaving, ultraviolet C (UVC) light, and ozonated water can be effective in controlling infection. Arita et

al suggested that ozonated water may be useful in reducing the number of Candida albicans on denture plates. The use of microwave energy to disinfect dentures was suggested to overcome problems associated with chemical disinfection. Andersen et al suggested that disinfection with UVC light might notably reduce environmental bacterial contamination, and the product is currently being sold for denture cleaning. Although several techniques were shown to disinfect dentures, no comparative study has been performed to determine the most effective denture cleaning method.[15- 20]

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