Original Article

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EFFECT OF SIX DIFFERENT DENTURE CLEANSING AGENTS ON FRACTURE RESISTANCE AND SURFACE ROUGHNESS OF HEAT CURE RESIN DENTURE BASE MATERIALS

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ABSTRACT:

Aim: The purpose of this study was to evaluate the effect of 6 different denture cleanisng agents (i.e. homemade vinegar, 5% baking soda, bleaching agent 1% NaOCl and commercially available denture cleaning agents 2% chlorhexidine mouth wash, fittydent tablets, and betadine) on fracture resistance and surface roughness heat cure resin denture base materials.

Materials And Methods:70 standard rectangular samples (10×5×2mm) were prepared from heat cure acrylic resin. Before immersion in these cleansing agent's surface roughness was measured. Fracture resistance was measured between control group and other groups. After immersion in these denture cleansing agents for 7 days, surface roughness and fracture resistance were measured

Results: According to the results obtained, surface roughness values were increased in samples immersed in vinegar solution followed by samples immersed in 1% bleaching agent when compared to the control group . Fracture resistance was more for samples immersed in betadine solution, while it was less for samples immersed in 1% bleaching agent followed by vinegar, Fittydent tablets and chlorhexidine mouth wash. There was no statistical significance between betadiene samples and control group.

Conclusion: The results of the present study showed that there was a significant increase in surface roughness of samples which were immersed in vinegar for 7 days. The fracture resistance was less i.e. the samples were more prone to fracture stored in 1% bleaching agent for 7 days. Samples stored in effervescent commercially available denture cleaning tablets didn't show significant difference in change of surface roughness and fracture resistance.

Key Words: Acrylic resins, cleansing agents, surface roughness, fracture resistance.

INTRODUCTION:

The awareness for the need of infection control in cross-contamination during dental procedures for patients, dentists and laboratory technicians has increased due to the prevalence of some infectious diseases such as AIDS and Hepatitis B.[1] Potential sources of transmission of infectious diseases from patients to dental technicians include prostheses in contact with oral tissues, saliva and blood. When prostheses were to be removed from patient's mouth at various stages of trial and insertion, they may be contaminated by pathogenic organisms which can be transmitted through direct contact with the aerosol raised during trimming, finishing and polishing procedures.[2]

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The need to disinfect prostheses has resulted in the widespread search for disinfectant agents that are innocuous to the prosthesis surface.[3] Various chemical agents can be used in prosthesis disinfection, i.e.chlorine, iodophors and aldehyde compounds. 1% sodium hypochlorite, 4% chlorhexidine gluconate and 3.78% sodium perborate proved to be effective in reducing the number of microorganisms on dental prostheses. Chlorine dioxide (Alcide LD) is effective in eliminating microorganisms from the internal and external surface of acrylic resin.[3] Both the outer and inner surfaces of a dental prosthesis must be disinfected becausethey are both potential sources of contaminate microorganisms.[3]

Carvalho et al recommended that 0.525% sodium hypochlorite solution for disinfection. Several other studies have demonstrated that various chemical disinfectants affect the physical properties of denture base resins such as hardness, transverse strength, roughness and deterioration on the surface of the denture resin.[4]

The colour stability of denture base resins can be significantly affected by disinfectant solutions such as glutaraldehyde, Chlorhexidine, phenolic- based, alcohol-based and hypochlorite disinfectants. [5] The first type of chemical disinfectant to be given extensive trial by the general public is Sodium hypochlorite which was quite effective particularly against Tobacco, food stain, bacteria and viruses. Many researchers had confirmed that NaOCl is most effective agent against bacteria if it is used for regular immersion. [5]

Smith et al found that NaOCl caused bleaching and whitening, water absorption in resin materials and loss of soluble component. The second universal disinfectant chemical solution chlorhexidine, was effective against Candida species**,** which was a significant cause of denture stomatitis. About 60% candida species which were found on the fitting surface of maxillary denture showed a tendency to decrease by immersion of the denture in solution of chlorhexidine.[6]

The best disinfectant should fulfil most of the requirements of the ideal agent while not causing any kind of alteration in the structure of the dentures. Sodium hypochlorite is inexpensive, presents a broad spectrum of activity and requires a short period of disinfection. Tablets of sodium perborate and alkaline peroxide based denture cleansers were also commonly used for denture cleaning and for maintaining hygiene.[7]

The aim of this study was to evaluate and compare the effects of 6 different denture cleanisng agents (i.e. homemade vinegar, 5% baking soda, bleaching agent 1% NaOCl and commercially available denture cleaning agents 2% chlorhexidine mouth wash, fittydent tablets, and betadine) on the surface roughness and fracture resistance of heat cure denture base materials.

MATERIALS AND METHODS:

Materials required were heat cure denture base resin material, homemade vinegar (Fig 1), bleaching agent 1% NaOCl(Fig 2), 5% baking soda (Fig 3) and commercially available denture cleaning agents betadine (Fig 4), 2% chlorhexidine mouth wash (Fig 5) and fittydent tablets(Fig 6).

Fig 1: Vinegar

Fig 2: NaOCl

Fig 3: Baking soda

Fig 4: Betadiene Solution

Fig5: CHX Solution

Fig 6: Fitty Dent Tablets

According to ISO standardization 1567 rectangular model (10×5×2mm) (Fig 7), seventy rectangular shaped wax patterns were prepared. All the wax patterns were flasked with dental stone in metallic flasks (Fig 8). After the setting of stone, the flask halves were separated, the wax was removed and the stone mold was cleansed. The resin was manipulated packed and pressed into the mold according to the manufacturer's instructions. The heat polymerization acrylisation method was followed i.e. water at 74 °C for 2 hours, followed by water at 100 °C for 1 hour. All the flasks were allowed to cool to room temperature before opening.

After polymerization of the resin, the samples were removed from the molds. Bench cooling was done by allowing the flask to cool at room temperature for 1 hr and then immersed in distilled water at 37 ± 1 °C for 48 hours for residual monomer elimination.

The samples of acrylic resins were finished by using acrylic bur to remove any feather edges & then smoothed by using sand paper of 180, 220, 400 grit to remove any small scratches.

Then test samples (Fig 9) were randomly divided into 6 groups (n=10) and surface roughness values were measured by using a profilometer. The samples were immersed for 1 week (5 hours per a day) in distilled water as a control group and 6 different cleansing agents (i.e. homemade vinegar, 5% baking soda, bleaching agent 1% NaOCl and commercially available denture cleaning agents 2% chlorhexidine mouth wash, fittydent tablets and betadine.

After the immersion procedure is completed, the surface roughness of each test specimen was measured again and the values were obtained (Fig 10). The roughness values before immersion were subtracted from the values after immersion to obtain the ΔRa (surface roughness differences).Each specimen was fixed on the table of the Instron testing machine and the fracture toughness was measured (Fig 11).

Fig 7: Rectangular wax patterns Fig 8: Wax patterns flasked

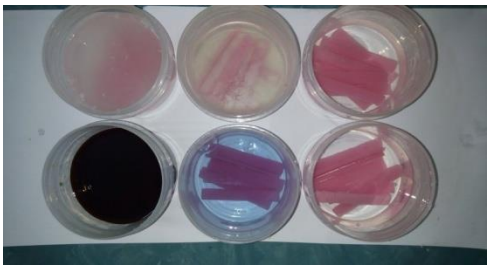


Fig 9: Samples placed in denture cleansing agents

Fig 10: Samples evaluated for surface roughness using profilometer

Fig 11: Samples evaluated for fracture resistance using UTM

RESULTS:

The post-immersion surface roughness of acrylic resin was recorded using a surface profilometer. Data was recorded to the nearest of 0.01 µm with a surface analyzer (Surface Roughness Analyzer). According to the statistical results obtained, surface roughness values increased in samples that were immersed in vinegar solution followed by samples immersed in 1% bleaching agent when compared to the control group. The effect of denture cleansers on the fracture resistance of denture base after 7 days immersion was observed.

Fracture resistance was more for samples immersed in betadine solution, while it was less in samples immersed in 1% bleaching agent followed by vinegar, Fittydent tablets and chlorhexidine mouth wash. There was no statistical significance between betadiene samples and control group.

On Comparison of mean between groups for surface roughness by using Kruskal-Wallis Test (Table 1) shows that there was high statistical significance i.e. (p value <0.01) for roughness values of various denture cleansing agents i.e. bleaching agent, baking soda, vinegar, chlorhexidine mouth wash, betadiene and fittydent. Among them higher values were obtained for vinegar followed by bleaching agent, baking soda, butadiene, chlorhexidine mouth wash, fittydent tablets and water (control group). The chi-squared test value is 33.98 which determines that there is a significant difference between the expected frequencies and the observed frequencies.

Schematic representation (Graph 1) for surface roughness among control group, bleaching agent, baking soda, vinegar, chlorhexidine mouth wash, betadiene and

fittydent. Among them higher values were seen for vinegar followed by bleaching agent, baking soda, betadiene, chlorhexidine mouth wash, fittydent tablets and water (control group).

On Comparison of mean between groups for fracture resistance by using Kruskal-Wallis test (Table 2) shows that there was a statistical significance i.e. (p value <0.05) for fracture resistance value of various denture cleansing agents i.e. bleaching agent, baking soda, vinegar, chlorhexidine mouth wash, betadiene and fittydent. Among them higher values were obtained for betadiene solution followed by baking soda, fittydent tablets, vinegar, chlorhexidine mouth wash and bleaching agent. The chi-squared test value is 12.92 which determines that there is a significant difference between the expected frequencies and the observed frequencies.

Schematic representation (Graph 2) for surface roughness among control group, bleaching agent, baking soda, vinegar, chlorhexidine mouth wash, betadiene and fittydent. Among them higher values were obtained for betadiene solution followed by baking soda, fittydent tablets, vinegar, chlorhexidine mouth wash and bleaching agent.

Table 1: Comparison of mean between groups for SURFACE ROUGHNESS by using Kruskal-Wallis Test

Groups (RA)	Mean	Median	SD
Water (control	0.8	0.76	0.11
Bleaching agent	1.73	1.75	0.47
Baking soda	1.68	1.73	0.21
Vinegar	1.76	1.82	0.21
CHX mouth wash	1.39	1.37	0.16
Betadine	1.42	1.4	0.12
Fittydent	1.35	1.35	0.3
Chi-square value=33.98	**P-value <0.01**		**HS**

Graph 1: Schematic representation of comparison of mean between groups for surface roughness

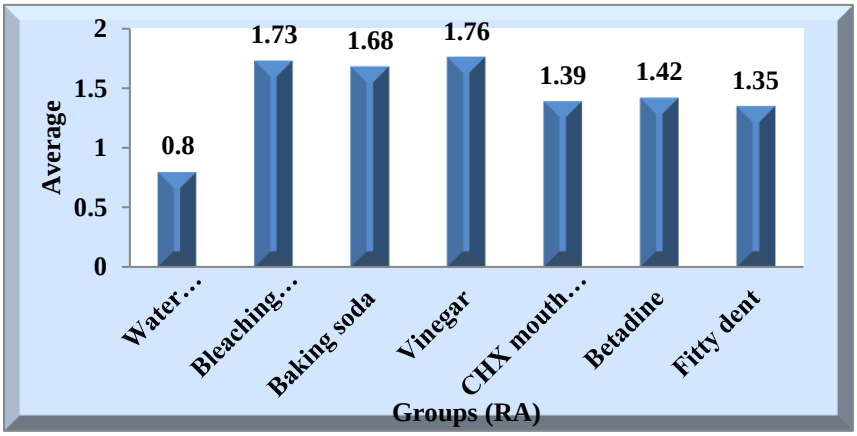
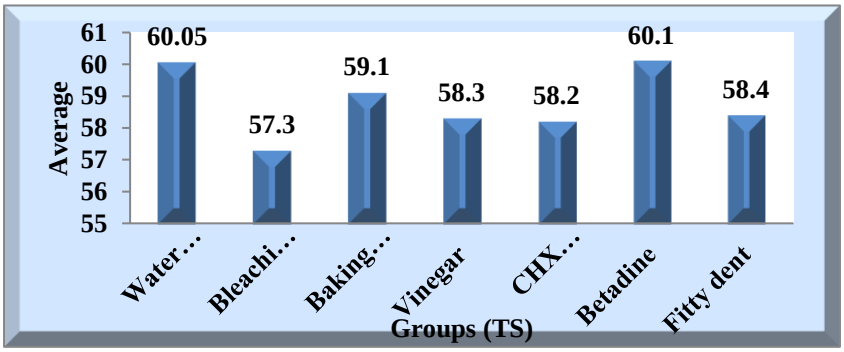


Table 2: Comparison of mean between groups for fracture resistance by using Kruskal-Wallis test

Groups (TS)	Mean	Median	SD
Water (control)	60.05	60	1.1
Bleaching agent	57.3	57.5	2.06
Baking soda	59.1	59	1.52
Vinegar	58.3	58	1.49
CHX mouth wash	58.2	58.5	2.04
Betadine	60.1	60	1.2
Fittydent	58.4	59	1.71
Chi-square value=12.92	**P-value <0.05**		**S**

Graph 2: Schematic representation of comparison of mean between groups for fracture resistance.



DISCUSSION:

Acrylic resin bases for both removable partial and complete dentures attract stains and odour producing organic and inorganic deposits. The rate at which the deposits accumulate on dentures may vary between individuals and can be affected by factors such as salivary composition, dietary intake, surface texture and porosity of the denture base material and also duration for which the dentures were worn and the denture cleansing regimen adopted by the wearer.[1,2]Denture cleansing is necessary to remove extrinsic stains,soft and hard deposits from dentures. The micro porous surface of an acrylic resin denture base material provides an environment that supports the growth of microorganisms that may add to further staining of dentures.[3]

To avoid the risk of cross-infection and to reduce microorganism's colonization different prostheses disinfection procedures have been studied and applied routinely either by washing or brushing with chemical agents, microwave irradiation, immersion in disinfectant

solutions and use of effervescent cleansing tablets.[8]

Roughness affects the patient's comfort and prosthesis longevity. A smoother surface leads to better esthetic results and less bio film retention.[8] Several authors emphasized that irregular surfaces increase retention of the microorganisms and may affect oral health. The best disinfectant should fulfil most of the requirements of the ideal agent while not causing any kind of alteration in the structure of the dentures. Denture cleaning by immersion in chemical solution should not involve any physical, mechanical or chemical change in acrylic resin.[9] In this study, roughness values increased in the samples that were disinfected with vinegar in comparison to the other groups.

Vinegar contains acetic acid which causes hydrolysis of polymer chains in an aqueous environment resulting in an unstable polymer leading to increased surface roughness. Next is the bleaching agent which contains alkaline peroxides dissolved in water forms an alkaline solution of hydrogen peroxide which produces an effervescent action resulting in mechanical loosening action between the denture surface and the debris.[10] Sodium bicarbonate present in bleaching agent decomposes to form alkaline peroxide which subsequently releases oxygen. Roughness in acrylic portion can be attributed to the higher peroxide content and level of oxygenation that can cause hydrolysis and decomposition, which can be damaging to the denture base materials especially acrylic resin.Baking soda, contains sodium bicarbonate which alkalizes the water which cleanses the dentures and citric acid removes stains.[11]

Immersion in effervescent tablets did not influence surface roughness of samples like in homemade cleansers i.e. vinegar and bleaching agent which increased the surface roughness.[12] Commercially available denture cleansing agents like fittydent tablets contain sodium bicarbonate, Sodium Carbonate peroxyhydrate, trisodium phosphate which produces its action by effervescence effect and helps in maintaining the hygiene of the denture.[13]

Vinegar solution, which contains chlorogenic acid and acetic acid, will undergo chemical changes that affect the mechanical properties of the acrylic resin.[14]

According to the results obtained commercial denture cleansers did not affect the surface roughness.Vinegar (5-20% acetic acid) affects the roughness ΔRa values of test samples. Regardless of the denture cleaning solutions used there was a decrease in fracture resistance. Samples immersed in Betadine solution showed more value for fracture resistance compared to those immersed in other solutions as it contains free iodine which is slowly liberated from the povidone-iodine (PVP-I) complex kills eukaryotic or prokaryotic cells through iodination of lipids and oxidation of cytoplasmic and

membrane compounds. This agent exhibits a broad range of microbicidal activity against bacteria, fungi, protozoa
and viruses. Fracture resistance was less for those samples stored in 1% bleaching agent. There was no significant difference for the samples stored in 5% baking soda, vinegar, fittydent tablets, chlorhexidine mouth wash experimental group and control group. In addition, some studies reported the immersion of denture base in 2% alkaline glutaraldehyde for 1 hour, resulted in no significant effect on fracture resistance values.

CONCLUSION:

Within the limitations of the present study, it showed that there was a significant increase in surface roughness of samples which were immersed in vinegar and bleaching agent when compared to commercially available fittydent tablets for 7 days. The fracture resistance was less i.e. the samples were more prone to fracture stored in 1% bleaching agent for 7 days. Samples stored in effervescent commercially available denture cleaning tablets didn't show significant difference in change of surface roughness and fracture resistance. So, they can be used as a better denture cleaning aids.

Control of cross-infection has been a subject of interest to the dental area over the last few decades, due to the concern about the transmission of infectious-contagious diseases, such as AIDS, hepatitis, tuberculosis, pneumonia, and herpes, between the dental patients and dental personnel and the dental office and dental prosthesis laboratory. Proper cleaning and maintenance of denture prostheses are therefore important for the oral health of patients and to maintain odourless and stainfree prostheses. So, commercially available denture cleansing agents like fittydent can be used for maintaining the hygiene of dentures when compared to homemade agents like vinegar and bleaching agent.

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