IMPACT STRENGTH OF ACRYLIC RESINS AFTER STORAGE IN DENTURE CLEANSERS

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ABSTRACT

The aim of the study was to evaluate the impact strength of heat cure acrylic resin after immersed in distilled water and denture cleansers.

Study was conducted at Dr. Ishrat-ul-ebad Khan Institute of Oral Health Sciences from January to April 2013. Seventy two (72) rectangular shaped 13.0 mm in length and 4.0 mm thickness formed the study; Eighteen (18) specimens were measured at baseline (control group) of the study (0 day), 18 specimens were immersed in distilled water. Eighteen (18) specimens were placed in fittydent denture cleanser solution for 10 minutes and eighteen (18) specimens were placed in dentipur denture cleanser solution for 10 minutes. Specimens were polished, stored in distilled water for 24 hours prior to experiment. After 60 days of immersion the specimens were tested for impact strength with impact strength tester. SPSS 16 was used for statistical analysis. Charpys impact strength was significantly decreased after storage in fittydent and dentipur denture cleanser tablets (p<0.05). No statistically significant difference were observed in impact strength when stored indistilled water (p>0.05). These results suggest that the impact strength of denture base acrylic resin is influenced by denture cleansers used.

Key Words: Denture Base Resins, Impact strength, Denture Cleansers.

INTRODUCTION

Revision Received:

Revision Accepted:

Poly methyl methacrylate (PMMA) was first introduced in 1937 by Walter Wright and is currently the material of choice for fabrication of removable partial denture and complete denture.¹ PMMA is the most popular denture base material.² Using the conventional (polymer/monomer) dough molding process, virtually all dentures are constructed from PMMA based materials.³ Almost all these materials are processed by water-bath curing system.³ PMMA is being used in dentistry for various purposes, like making denture bases, artificial teeth, provisional restorations, surgical splints, stents and orthodontic appliances.⁴ These polymers are cost effective and processed by comparatively simple techniques. They are the material of choice for removable complete dental prostheses.⁵

It is of great importance to maintain the health of oral mucosa and hygiene of dentures in patients who

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Received for Publicatio	n: September 9, 2014

October 15, 2014 October 22, 2014

use partial and fixed removable dentures.^{6,7} Denture cleansers prevent denture-induced stomatitis, halitosis remove discoloring caused by foods and drinks, provide adequate denture plaque control and eliminate Candida albicans and Candida glabrataand other microorganisms, to dissolve calculus.⁸⁻¹⁰ The use of chemical agents may be the only means of denture hygiene in patients particularly those who are very old, have Alzheimer's disease, dementia or low motor capacity.^{11,12} According to their chemical composition denture cleansers can be classified as:, neutral peroxide, enzymes, alkaline peroxides, alkaline hypocholorites, disinfectants and acid.7 The most common commercial cleansers currently in use which require immersion techniques is alkaline peroxide.¹³ Gornitskyet al¹⁴ in their study evaluate perborate-based denture cleansers on the prosthesis and found out the excellent antimicrobial activity of these solution. McCabe et al¹⁵ confirmed that these solutions do not contain any abrasive particles and are favorable for hygiene of prosthesis. Fernandes et al¹⁶ reported that for removing Candida biofilms forms perborate solution was effective both in and polyamide and -acrylic based denture base resins.

It is of clinical importance to determine whether denture cleansers alter the properties of acrylic resins. Some authors have concluded that the daily use of

denture cleanser can affect the properties of denture acrylic resin.¹⁷ Denture base polymers are susceptible of color change¹⁸ if the cleaning solutions are not correctly used. The surface roughness is of great clinical relevance since it can affect biofilm formation and make it difficult to remove.¹⁹ A frequent problem that occurs with removable dentures is fracture, which may be due to accidental dropping, repeated masticatory forces, and areas of stress concentrations around frenal notches.³ For this reason, the impact strength (IS) of polymers used for the production of denture bases has been investigated. 20,21 The literature has shown that a 0.5% sodium hypochlorite solution is an effective denture cleanser for reducing microorganisms²² and it is also indicated for disinfecting denture liners and tissue conditioners, preventing oral candidiasis.²³ Conversely, it has been suggested that alkaline peroxide tablets decrease the number of C. albicans colony-forming units on maxillary dentures²⁴ and this cleaning solution is also considered to be an effective remover of bacterial plaque.²⁵

Therefore, the choice of appropriate methods for denture cleaning is clinically important, when the objective of the procedures is not cause surface damage of the denture base, and for daily use to prevent microbial adhesion.

METHODOLOGY

It was an in vitro experimental study conducted at Dr Ishrat-ul-Ebad Khan Institute of Oral Health Sciences and testing was performed at PCSIR Karachi, Pakistan from January to April 2013. The material tested in the study was heat-cure acrylic resin (Vertex rapid simplified, Holland).

Seventy two rectangular specimens 13.0 mm in length and 4.0 mm thickness were prepared from stainless steel mould. These dimensions were according to the American Society for Testing and Material Standard D 256-O6a. Material was polymerized according to manufacture instructions. After heat polymerization, specimens were removed from the mold, the flash was trimmed with a carbide bur and smoothened by the 200 girt sand papers with the help of sandpaper holder. The specimens were polished on a wet rag wheel with pumice slurry. After polishing, all specimens were placed in distilled water at room temperature for 24 hours.

The samples were divided into four groups: Eighteen specimens were measured at baseline (0 day) without immersion in any solution. This was the control group of the study. Eighteen specimens were measured after 60 days of immersion in distilled water; eighteen specimens were measured after 60 days of immersion in fittydent denture cleanser tablets for 10 minutes (According to manufacturer recommendations) and eighteen specimens were measured after 60 days immersion in Dentipur denture cleansers tablets for 10

minutes. (According to manufacturer recommendations) All specimens except the specimens in the control group (baseline) were placed in their respective containers and filled with distilled water. The specimens in the control group were measure at 0 day. After 24 hours the distilled water was discarded and the container was filled with their respective denture cleansers. The specimens were washed with distilled water and stored in distilled water. This was repeated twice a day for total of 60 days. Specimens were placed in distilled water during storage. After 60 days, impact strength was evaluated using charpys impact tester (Ceast Resil Itlay). Data analysis was performed by using Statistical Package for Social Sciences (SPSS) version-16. The data was analyzed by using one way analysis of variance-one way (ANOVA) for a quantitative dependent variable by a single factor (independent) variable. To identify which of the mean differed significantly, Tuckey's HSD (Honestly significant difference) was used at 0.05 significance level.

RESULTS

The mean and standard deviation of impact strength test data are shown in Table 2. The fittydent denture cleanser solution showed highest reduction in the impact strength as compared to baseline (0 day). This was followed by dentipur denture cleanser solution in which specimens were immersed for 60 days twice a day simulating 120 cycles. The specimens immersed in distilled water showed lowest reduction in the impact strength in comparison with control group. One way analysis of variance (ANOVA) showed that statistically significant differences were found (p < 0.001) when specimens were stored in baseline (control) and when specimens were stored in fittydent and dentipur solution (Table 3). It showed that the storage medium had an effect on the impact strength of heat cure acrylic resins. Post hoc analysis for impact strength was done by Tukey HSD (Honesty Significant Difference) analysis to determine the difference among the groups. After Post hoc analysis by Tukey HSD, statistically insignificant values were observed when the specimens at baseline (0 day) were compared with the specimens immersed in distilled water. However statistically significant difference were observed when the specimens were immersed in distilled water and compare with the specimens at baseline (0 day) The Post Hoc results showed statistically significant differences when specimens were stored in fittydent denture cleanser solution and dentipur denture cleanser solution.

DISCUSSION

To avoid the risk of cross-infection and to reduce microorganism's colonization different prostheses disinfection procedures have been studied and applied routinely. These procedures are washing and brushing with chemical agents, microwave irradiation, immersion in disinfectant solutions and use of effervescent cleansing tablets, commonly used to clean dental prostheses.²⁶

TABLE 1: MATERIAL USED IN THE STUDY

Material	Туре	Processing method	Manufac- turer
Heat cure acrylic resins	PMMA	Heat cure polym- erization 100OC for 20 min in the curing tank	Vertex™ Rapid Sim plified

TABLE 2: MEAN AND STANDARD DEVIATION OF CHARPY IMPACT STRENGTH AT BASE LINE (0 DAY) AND 60 DAYS IMMERSION IN CONTROL GROUP (DISTILLED WATER) AND EXPERIMENTAL GROUPS

Groups	Mean and Standard Deviation
Baseline (0 day)(control)	$13.96 \pm 0.64^{\rm b}$
Distilled water	$12.611 \pm 0.50^{\circ}$
Fittydent denture cleanser tablets	9.023 ± 1.79^{a}
Dentipur denture cleanser tablets	9.680 ± 1.60^{a}

Means with the same letters were not significantly different at p=0.05

TABLE 3: RESULTS OF ONE WAY ANOVA FOR MEAN VALUES OF CHARPYS IMPACT STRENGTH

Ν	Groups	Sum of squares	Df	Mean square	Sig value
72	Baseline Control Fittydent Dentipur	299.424	3	99.808	<0.001

To complement denture hygiene chemical cleansing is usually associated with mechanical cleansing as for good denture biofilm control brushing alone is not sufficient.²⁷ For patients with impaired manual dexterity, chemical denture cleansing have become increasingly more popular due to ease of use. In the past, chemical cleansing was thought to possibly damage denture base materials, especially acrylic resins.²⁸ This study was undertaken to evaluate any mechanical alterations in heat-polymerized denture base acrylic resins, after soaking in different denture cleansers for 60 days twice a day simulating 120 cycles. It has been shown that by immersing in certain cleansing solutions the strength and the structure of denture base resins can be affected.²⁹ If these chemicals affect negatively there would be greater incidence of fracture of these prosthesis. These fractures may occur either inside or outside the mouth. If the denture dropped accidently and the denture has low impact strength fracture occur outside the mouth. Whereas inside the mouth, heavy occlusal forces might cause denture base to fracture. Increased frequency of this type of failure due to use of denture cleansers,can be demonstrated by impact strength testing. Ideally, a complete denture resin must offer sufficient impact strength while extra orally high impact forces may occur as a result of dropping the prosthesis.³⁰

The Charpy type test selected for the present study has been used by investigators to evaluate the IS of denture base acrylic resins.^{30,31,32} The work hypothesis that denture cleansers would not have a significant effect on the IS of the denture base resin was rejected. The selection of denture cleanser depends on many factors and since these chemical solutions can cause substantial deterioration on the soft liners, compatible materials should be considered to avoid or minimize any changes in the favorable physical or chemical properties.³³ Future In vivo studies are recommended if the results of the current and other previous studies are clinically applicable. In a study conducted by Pisani MX et al³³ authors found that the use of sodium perborate did not promote significant alterations in the evaluated properties.

The soaking trials followed the manufacture recommendations. Significant differences in impact strength were found Pavarina AC²¹ conducted a study on the evaluation of strength of heat cure acrylic resins after immersing into disinfectants; they did not find any significant changes in the strength. The disinfectants used in the study were 4% chlorhexidine, 1% sodium hypochlorite and 3.78% sodium perborate. These results might be due to the fact that the specimens were submitted to disinfection twice, simulating when dentures come from the patient and before being returned to the patient. In a study conducted by Mansoor NS et al³⁴ the authors immersed their specimens in denture cleansers and they did not find any significant difference in the impact strength of heat cure acrylic resins. Similarly, in a study conducted by Peracini A et al³⁵ authors evaluated the strength of heat cure acrylic resins after immersed in denture cleansers solution and they found a marked decrease in the strength. The decrease in the impact strength of in the both the studies may be due to the reason that long term exposure to denture cleansers results in absorption of organic and inorganic components of denture cleansers by the polymer network. Water molecules incorporated in between the polymer chains cause swelling of the meshwork and reduces the frictional forces in between the chains. As a result the chains of polymers move far a part from each other results in decrease strength of the material. The decrease in the impact strength of the specimens may be due to the fact that the heat cure acrylic resins used in the present study was polymerized through short curing cycle. This might lead to increase content of residual methylmethacrylate. This result in decrease strength of the material as residual MMA adversely effects the properties of resins.

CONCLUSION

Within the limitations of this study, following conclusion can be drawn: Ten minutes immersion, twice a day for 60 days in Fittydent denture cleansers tablets and Dentipur denture cleansers tablets resulted in significant decrease in impact strength of the heat cure acrylic resin material.

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