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Comparative study on effect, denture cleanser and disinfectant have on flexural strength of PMMA

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Abstract

In selecting a disinfectant for dental prosthesis, compatibility between the disinfectant and the type of denture base material must be considered to avoid adverse effects in the acrylic resin. In this study a total of 75 specimens of heat cure acrylic of dimension (65x10x3) mm were prepared. 15 specimens were immersed in distilled water, used as control and 60 samples were treated. 30 were treated with 4.8% of sodium perborate (Fittydent®) at 50 °C for 8 hours and 24 hours. The third group were treated with 2.45% alkaline glutaraldehyde (Cidex®) at 37 °C for 20 min and 1 hour. All the specimens were subjected to three point flexural load in universal testing machine. The findings were analyzed using one way Analysis of Variance (ANOVA). Acrylic resin selected for this study did not demonstrate any significant difference in flexural strength after immersion. As the flexural strength of the denture base resins remained unaffected, all immersion solutions evaluated in this study could be safely applied in everyday practice for the disinfection of dentures.

Keywords: Denture Cleanser, Disinfectants, Poly (methyl methacrylate), Flexural strength

1. Introduction

Poly (methyl methacrylate) was introduced in 1937 by Dr. Walter Wright^[1] and since then it has been successfully used for denture bases, artificial teeth, denture repair, impression trays and many other applications in dentistry. As dental personnel become more aware of the modes of transmission of numerous infectious microorganisms during dental procedures, infection control in dental practice has received increasing attention. However, Poly (methyl methacrylate) has always been masked by an inherent strength characteristics, which includes poor impact strength and fatigue resistance^[2].

Commonly available denture cleanser agents

1. Alkaline peroxide solution - Daily, overnight immersion of dentures provides a safe and relatively effective means of cleaning dentures. These products do not have any significant effect, when only a 15- to 30-minute immersion period is used.
2. Hypochlorite - Effective with overnight immersion, but because of bleaching, they should be used only intermittently. Hypochlorite may damage a cobalt-chromium or stainless steel base.
3. Dilute acids –
 - a. Diluted Acetic acid are effective in dissolving calculus by overnight immersion, but only at weekly or biweekly intervals because they are corrosive.
 - b. Cleansers based on commercially available Hydrochloric acid are hazardous to use and should not be recommended^[3].
 - c. Vinegar solutions - Effective in killing microorganisms that reside on the surface of dentures. The acid nature of vinegar makes it especially effective at removing calculus.
4. Chlorhexidine gluconate – Effective at 0.2% solution
5. Trisodium phosphate - Trisodium phosphate reacts to cause effervescence with liberation of oxygen bubbles from the solution.

A study conducted by Jorgensen^[4] in 1979, evaluated the nature and behavior of denture cleansers and the results showed that denture cleansers appear to be harmless to dentures. Similarly sodium hypochlorite acts as an efficient disinfectant. In the same study alkaline peroxides were found to be the most commonly used denture cleansers. But, peroxide cleansers may cause bleaching of acrylic resin, which in turn may decrease transverse strength.

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Alkaline hypochlorites are effective as they are fungicidal and bactericidal. However the significant disadvantage of hypochlorite is its tarnishing and corroding of metal components and bleaching of acrylic resins which can affect transverse strength [4]. The aim of this study was to evaluate the effects of denture cleanser and disinfectant on the flexural strength of heat cured denture base resin.

2. Materials and methods

Heat polymerized poly (methyl methacrylate). DPI heat cure™ polymer and DPI heat cure™ monomer (Dental products of India Ltd.) was selected for this study. Denture cleanser solution Fitty® Dent super cleansing tablets contains 4.8 % of sodium perborate. (Dr. Reddy’s laboratories) and disinfectant solution Cidex® (Johnson and Johnson) contains 2.45% alkaline glutaraldehyde (Fig. 2) were selected and used a per manufactures recommendation.

2.1 Steps of fabrication

1. The specimens of dimension 65 x 10.0 x 3mm think were prepared (As per ISO 1567). For this customized 4 piece brass mold of dimensions 102 mm x 95 mm x 10 mm, was fabricated which contained 4 mold spaces corresponding to the dimensions. Appropriate instrument were used to mix the resin and a digital caliper to evaluate if the final specimens were as per standardization. (Fig 1)
2. Heat polymerized acrylic resin was mixed in the ratio of 1:3 by volume. When the dough stage was reached. i.e., when material separated cleanly from the sides of the mixing jar, it was kneaded and packed into the mold spacers of the customized mold.
3. Pressure was used to close this mold in the bench press. Customized mold was then transferred to a clamp and was allowed to bench cure for 30 min. It was then immersed in the water bath in an acrylizer and curing was done at 74 °C for 2 hrs. followed by 100 °C for 1hr. After curing it was allowed to bench cure slowly 1 day.
4. The customized mold was then opened, polymerized acrylic resin specimens was then retrieved and hand finished using 400 grit silicone paper to final dimension of 65 mm x 10mm x 3mm which was measured by a digital calliper.
5. The specimens were then subjected to heat treatment (10 minutes in water at 55 °C) to reduce the residual monomer. The specimens were then stored in distilled water at room temperature for 7 days before subjected to disinfection and flexural strength testing.

2.2 Preparation of solutions

- a. 1 Fitty® Dent super cleansing tablets was immersed in 100 ml of water at 50 °C
 - b. 100 ml Cidex® at room temperature
- After 7 days the specimens were then appropriately labelled and transferred in groups of 15 to prepared solutions for treatment. The holding containers were appropriately labelled with date and time for storage and date and time of testing for easy reference. The 4 experimental groups which contained 15 specimens each, were divided as described.

2.3 Study group

- a) A₁ Heat polymerized acrylic resin bars treated with Denture cleanser solution Fitty® Dent super cleansing solution for 8 hours.
- b) A₂ Heat polymerized acrylic resin bars treated with Denture cleanser solution Fitty® Dent super cleansing

solution for 24 hours.

- c) B₁ Heat polymerized acrylic resin bars treated with Cidex® Disinfectant solution for 20 min.
- d) B₂ Heat polymerized acrylic resin bars treated with Cidex® Disinfectant solution for 1 hour.

e) Control 15 specimens were immersed in distilled water After the immersion time had elapsed, each group of specimens were subjected to 3 point bending test device in Rauenstein Universal Testing machine to evaluate the flexural strength (Fig.3). The Universal Testing Machine consisted of a loading wedge and one pair of adjustable supporting wedges placed 50 mm apart. The breaking load values were converted to flexural strength values in Mega Pascal (MPa), which were then statistically analyzed using one way Analysis of variance (ANOVA).

3. Results & Discussion

In the present study, the descriptive statistic with mean and standard deviation of Group A₁, Group A₂, Group B₁ and Group B₂ compared to Control (Table 1). One way analysis of variance (ANOVA) used to analyze total data (Table 2). An F value 1.211 and P value 0.314 was found, which was non-significant. Since difference observed is non-significant, we infer that there is no difference in between the groups. The results of the present study showed that flexural strength of denture base resin did not show significant changes after immersion in disinfectant solution and denture cleanser when compared to control (water). Since flexural strength depends on the bulk of the material, an insignificant change in flexural strength indicates that the bulk of the material remained intact from the influence of the solutions. As the flexural strength of denture base resin remained unaffected after immersion in disinfectant and denture cleanser, all the immersion solutions evaluated in this study could be safely applied in everyday practice for the disinfection of dentures when the manufactures instructions were followed.

3.1 Tables and Figures

Table 1: Descriptive statistic with mean and standard deviation of Group A₁, Group A₂, Group B₁ and Group B₂ compared to Control.

	N	Mean	Std. Deviation	Minimum	Maximum
Control	15	98.68427	4.529526	92.491	110.511
A ₁	15	96.23040	5.051948	87.051	104.833
A ₂	15	95.45813	6.501649	78.154	107.281
B ₁	15	95.86880	3.08749	91.278	102.623
B ₂	15	95.82546	2.93945	88.048	98.724

Table 2: One way analysis of variance (ANOVA) used to analyze total data.

	F	Significance (P)
Between Groups	1.211	0.314

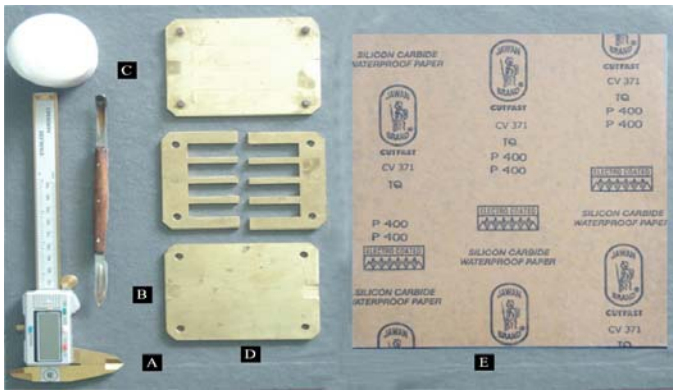


Fig 1: Instruments used in the fabrication of the specimens A: Digital Caliper, B: Wax Knife, C: porcelain Jar, D: 4 piece brass mold, E: Silicon carbide paper



Fig 2: Fitty® Dent Super cleansing tablets (sodium perborate), B: Cidex® alkaline glutaraldehyde

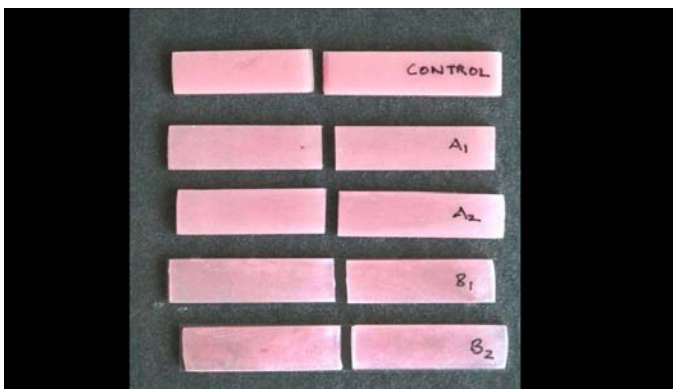


Fig 3: Test specimens after subjecting to 3 point bending test device in Rauenstein Universal Testing machine

4. Conclusion

Within the limitations of the present study and on the basis of results obtained, it can be concluded that the flexural strength of heat cured denture base resins after immersion in 4.8% sodium perborate for 8 hours and 24 hours and 2.45% glutaraldehyde for 20 minutes and 1 hour did not demonstrate any significant changes when compared with the control (distilled water). The results obtained were in agreement with study by Sato S. *et al.* [5] who evaluated the effects of denture cleansers at 15 min and 8 hours of soaking and the subsequent changes in flexural strength of heat polymerized Poly (methyl methacrylate) which showed no significant change in the flexural strength of the denture base resin studies. The results were also in agreement with the studies carried out by Polyzois GL [6] who concluded that immersion of denture base resins in 2% alkaline glutaraldehyde for 1 hour and 12 hours did not affect the transverse strength. But all specimens exhibited liner

changes during disinfection procedure. Similar results were also found by Robinson JG *et al.* [7] who conducted a series of tests which was devised to assess the effect of subjecting acrylic resin denture materials, to denture cleanser at recommended and elevated temperatures. The results concluded that heat-cured specimens which had whitened also suffered a reduction in flexural strength and microscopy, indicated changes in the interstitial matrix of the two-phase structure of the resins. Subsequent studies done by Crawford CA. *et al.* [8] and Arab J. *et al.* [9] also concluded that heightened temperature beyond manufactures recommendation caused a decline in flexural strength of denture base reins over repeated exposures. The studies emphasized that though denture cleansers were a safe method for disinfection of dentures, the guidelines followed by the manufacturer should be followed.

Clinical significance

5. References

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