

ORIGINAL ARTICLE**A COMPARISON OF EFFECT OF DENTURE CLEANSERS ON THE COLOR STABILITY OF HEAT CURE ACRYLIC RESIN- AN IN VITRO STUDY**Yujika Bakshi¹, Nitin Ahuja²¹Department of Prosthodontics, D.J. College of Dental Sciences & Research, Modinagar, Distt.- Ghaziabad, U.P²Department of Oral Pathology and Microbiology, Manav Rachna Dental College, Faridabad, Haryana, India.**ABSTRACT:**

Background: This study was conducted to compare the color stability of heat cure acrylic resin after immersion in distilled water and denture cleansers such as fittydent, dentipur denture cleanser. **Materials and Methods:** It consisted of forty rectangular shaped specimens; divided in four groups. Group I contained 10 specimens which were measured at baseline (control group) of the study (0 day), group II consisted of 10 specimens which were immersed in distilled water. Group III consisted of 10 specimens immersed in Fittydent denture cleanser tablets for 10 minutes and group IV contained 10 specimens immersed in Dentipur denture cleanser tablets for 10 minutes. Specimens were polished and stored in distilled water for 24 hours prior to experiment. After 60 days of immersion, the specimens were tested for color changes with spectrophotometer. **Results:** There was statistically significant difference in the color change (ΔE) among all groups ($p < 0.001$) after 60 days of immersion. At baseline (0 day), trace amount of color change was observed whereas when specimens were immersed in Fittydent denture cleansers tablets for 60 days noticeable change in color was observed. Very slight change in color was observed when specimens were immersed in distilled water and dentipur denture cleanser solution. **Conclusion:** Author concluded that the color stability of denture base acrylic resin was influenced by the type of denture cleansers used.

Key words: Denture Cleansers, Color Stability, Acrylic Resin.

Corresponding author: Dr. Nitin Ahuja, Reader, Department of Oral Pathology and Microbiology, Manav Rachna Dental College, Faridabad, Haryana, India. E mail: dr.nitinahuja@gmail.com

This article may be cited as: Bakshi Y, Ahuja N. A Comparison of effect of Denture Cleansers on the Color Stability of Heat Cure Acrylic Resin- An in vitro study. Int J Res Health Allied Sci 2016;2(1):14-17.

INTRODUCTION

It is often difficult to restore a satisfactory smile to patients with removable dentures. Acrylic resin, a denture base material, that is used commonly in dental practice, has disadvantages of being hard, easy to fracture and staining¹. In the past, many materials have been used for construction of these prosthesis. These materials include wood, ivory, and metals. The most popular denture base material for more than 50 years has been heat-cured poly (methylmethacrylate) (PMMA); however, impact resistant resins have been developed. In 1937, polymethylmethacrylate resins (PMMA) were introduced as denture base resins. Because of low cost and relative ease of manipulation, complete and partial dentures are fabricated from these acrylic resins.²

Under surface of dentures provides environment for the growth of both pathogenic and non-pathogenic microorganisms.³ Presence of candida under denture is very common due to favourable environment for their growth. The adhesion of *Candida albicans* on the fitting of the denture bases or lining materials appeared to be of critical importance for development and maintenance of denture stomatitis in continuous denture wearing. Thus, proper hygienic care of dentures is important for maintaining a healthy oral mucosa in denture wearers.⁴ Contaminated dentures need to be disinfected as part of denture hygiene regimen. Cleaning of the dentures can be accomplished by three well known methods. These are: mechanical, chemical and combination of these two.⁵

MECHANICAL METHOD

This is the most used method amongst elderly patients for removing denture biofilm. It is done by brushing with soap or an abrasive paste and water. The only disadvantage of this method is that effective biofilm removal requires a degree of manual dexterity that is often lacking particularly amongst elderly individuals.⁶

CHEMICAL METHOD

This is another method for disinfection for dentures. In this, cleaning by immersion in disinfectant solutions should be considered. The disadvantage is that this method may cause adverse effect on the material, such as denture staining and compromised strength.⁷ To avoid adverse effects on the properties of denture base resins, disinfectant must be chosen that should have compatibility with the type of material to be disinfected. The chemical agents of denture cleansing solutions should be simple to use, effectively remove organic and inorganic matter from denture surface, and have bactericidal, antifungal and biocompatibility properties.⁸

Commercial denture cleansers may be classified according to their mechanism of action. By soaking the prosthesis in chemical solutions, the dentures can be chemically disinfected. Kumar *et al.*⁹ observed that denture cleansers were highly effective against *Candida albicans*. The effectiveness of commercial denture cleansers was significantly better than that of household denture cleansers.

Color stability of the denture material is very important for patient compliance. Denture base resins must match the color and appearance of the oral tissues to provide satisfying esthetic results for our patients. Long-term color stability in denture resins starts with the resin maintaining its color and translucency during processing. Color change of the dental material can lead to poor esthetics. Further the acrylic resin constitutes organic materials and it is likely to undergo deterioration of its translucency and colour.¹⁰ The discoloration or deterioration of colour pose an aesthetic problem and critically viewed on the point of acceptance from the patients' side challenging the prosthodontic workability and skill. To eradicate possible subjective errors in color assessment, spectrophotometric analysis is obtained as numerical values and it detects the visible light through color spectrum (400 - 700 nm).¹¹ So dentist should prescribe only those cleansers that remove microbial load but would not compromise the color of prosthesis. The purpose of the study was to determine the influence of

denture cleansers on the color stability of heat cure acrylic resins.

MATERIALS AND METHODS

This was an in vitro study conducted in the department of Prosthodontics, from Jan. 2014 to Dec. 2015. The heat cure acrylic material was used for this study.

Forty rectangular specimens 10.0 mm in length and 5.0 mm thickness were prepared from stainless steel mould. Material was polymerized according to manufacturer's instructions. After heat polymerization, specimens were removed from the mould, the flash was trimmed with a carbide bur and smoothed by the 200 grit 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 of 10 specimens each. First group was the control group which included 10 specimens who were measured at baseline (0 day) without immersion in any solution. Second group included 10 specimens who were measured after 60 days of immersion in distilled water.

Third group included 10 specimens who were measured after 60 days of immersion in Fittydent denture cleanser solution for 10 minutes, (according to manufacturer's instruction).

Fourth group consisted of 10 specimens who were measured after 60 days immersion in Dentipur denture cleanser solution for 10 minutes (according to manufacturer's instructions).

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 measured at 0 day. After 24 hours the distilled water was discarded and the container was filled with their respective denture cleansers. All the specimens were immersed in solution for 10 minutes. 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, color measurements were carried out using spectrophotometer.

Standardization of spectrophotometer is: pulse xenon light source, multiple aperture sizes to accommodate samples of different sizes, and automated specular port. The measurements were performed according to the CIE L*a*b* system and mean values for the material was calculated. In this three-dimensional color space, the three axes are namely L*, a*, and b*. The L* value is a measure of the whiteness or brightness of an object. The a* value is a

measure of redness (positive a*) or greenness (negative a*). The b* value is a measure of yellowness (positive b*) or blueness (negative b*). The advantage of the CIE L*a*b* system is that color differences can be expressed in units that can be related to visual perception and clinical significance.¹² The level of color change has been quantified by the National Bureau of Standards (NBS). Following formula is used to express NBS units. 1 NBS unit = ΔE x 0.92; where ΔE stands for color change. Data analysis was performed by using Statistical Package for Social Sciences (SPSS). P-value less than 0.05 were considered as significant.

RESULTS

TABLE I: Critical Marks of Color Difference According to National Bureau of Standards

Critical marks of color difference	Textile terms (NBS unit)
Trace	0.00 - 0.5
Slight	0.5 - 1.5
Noticeable	1.5 - 3.0
Appreciable	3.0 - 6.0
Much	6.0 - 12.0
Very much	> 12.0

TABLE II: Mean and standard deviation (SD) regarding color measurement of material after exposure to different media

Group	Mean and Standard deviation	P value
Control	14.02±0.54	<0.00
Distilled water	11.62±0.60	1
fittydent	8.23±1.60	
dentipur	9.26±1.58	

TABLE III: NBS values regarding color measurement of material after exposure to different media

Group	NBS (ΔE x 0.92)
Control	0.0042
Distilled water	1.24
fittydent	2.1
dentipur	0.92

Table I shows critical marks of color difference according to national bureau of standards (NBS). When the NBS value is 0.00 - 0.5, the color difference is trace. When it is 0.5-1.5 then it is slight. At 1.5 to 3.0 it becomes, noticeable. At 3.0 to 6.0 it becomes appreciable. At 6.0 to 12.0 ts is much and when NBS is more than 12, than it is very much.

Table II shows mean and standard deviation regarding color measurement of material after exposure to different media.

Table III shows NBS values regarding color measurement of material after exposure to different media.

DISCUSSION

This was an in vitro study to assess the effect of denture cleansers on the color stability of heat cure acrylic resin when immersed in distilled water, fittydent and dentipur solutions. Color stability has previously been studied *in vitro* for a variety of aesthetic restorative materials. Staining can be evaluated visually and by instrumental techniques (colorimeter and spectrophotometer).¹²

Causative factors that may contribute to the change in colour of aesthetic restorative materials include stain accumulation, dehydration, water sorption, leakage, poor bonding and surface roughness, wear or chemical degradation, oxidation of the reacted carbon- carbon double bonds that produces coloured peroxide compounds, and continuing formation of the coloured degradation products.¹³ The degree of colour change can be affected by a number of factors, including incomplete polymerization, water sorption, chemical reactivity, diet, oral hygiene and surface smoothness of the restoration. According to May et al¹⁴, colour change may be associated with porosity caused by overheating or insufficient pressure during polymerization.

The susceptibility to staining is determined by the properties of the denture base resins. The main staining mechanism is probably sorption of liquids. Studies have demonstrated a correlation between staining of denture base materials and water sorption and hygroscopic expansion. A denture base resin that absorbs water is also likely to absorb other liquids that contain staining agents.¹⁵ When a denture base resin absorbs water, its polymer matrix expands and separates the polymer chains. This allows staining agents to penetrate and discolor the denture base material. Water sorption can also occur without expansion if porosity is present in the resin. In the present study, the color of heat cure acrylic resins showed noticeable change in Fittydent denture cleansers tablets and slight change in color was observed in distilled water and Dentipur denture cleanser tablets. The results of present study are in consistent with Peracini *et al.*¹⁶, who also detected a significant discoloring effect on heat polymerized acrylic resins with denture cleansing agents.

To eradicate possible subjective errors in color assessment, the present study used a spectrophotometer for color measurements. Color changes were

characterized using the CIE L*a*b* system. The CIE L*a*b* color space is currently one of the most popular and widely used color spaces and it is well suited for the determination of small color differences. Based on the data obtained through the spectrophotometer measurement procedure, the null hypothesis tested in this study was rejected.¹⁷

According to Ruyter et al¹⁸, water may ultimately cause irreversible damage to acrylic by the formation of microcracks as a result of repeated sorption/desorption cycles. This results in hydrolytic degradation of the polymer by causing damage to the ester linkages and slow weakening of the infrastructure of the polymer.¹⁹ This leads to the formation of the acrylic zones with different optical properties, which can be esthetically undesirable and can be detected visibly. This could be the possible reason why heat cure resin was affected by distilled water in spite of the fact that like denture cleansers distilled water does not contain any sort of aromatic and preservative agents. In the present study, heat cure acrylic resin was affected not only by the experimental groups but also by the distilled water, although the color change by distilled water is less than by Fittydent denture cleanser tablets and more than by baseline measurements. There was statistically significant difference in the color change (ΔE) among all groups ($p < 0.001$) after 60 days of immersion. At baseline (0 day), trace amount of color change was observed whereas when specimens were immersed in Fittydent denture cleansers tablets for 60 days noticeable change in color was observed. Very slight change in color was observed when specimens were immersed in distilled water and dentipur denture cleanser solution.

CONCLUSION

Author concluded that by immersing the Specimens in distilled water and Dentipur denture cleanser tablets for 60 days simulating 120 cycles can cause slight change in the color of denture base resins. Also there was noticeable change in color when heat cure resin was immersed in Fittydent denture cleansers solution for 60 days simulating 120 cycles of immersion.

REFERENCES

1. Kawano F, Ohguri T, Ichikawa T, Mizuno I, Hasegawa A. Shock absorbability and hardness of commercially available denture teeth. *Int J Prosthodont* 2002; 15:243-7.
2. Orsi IA, Junior AG, Villabona CA, Fernandes FH, Ito IY. Evaluation of the efficacy of chemical disinfectants for disinfection of heat-polymerised acrylic resin. *Gerodontology* 2011; 28:253-7.
3. Jose A, Coco BJ, Milligan S, Young B, Lappin DF, Bagg J. Reducing the incidence of denture stomatitis: are denture cleansers sufficient? *J Prosthodont* 2010; 19:252-7.
4. Okubo SR, Kanawati A, Richards MW, Childress S. Evaluation of visual and instrument shade matching. *Prosthet Dent* 1998; 80:642-8.
5. Sabatini C, Campillo M, Aref J. Color stability of ten resinbased restorative materials. *J Esthet Restor Dent* 2012; 24: 185-99.
6. Brewer JD, Wee A, Seghi R. Advances in color matching. *Dent Clin North Am* 2004; 48:341-58.
7. Peracini A, Davi LR, Ribeiro NG, Souza RF, Silva CH, Paranhos HF. Effect of denture cleansers on physical properties of heat-polymerized acrylic resin. *J Prosthodont Res* 2010; 54:78-83.
8. Durkan R, Ayaz EA, Bagis B, Gurbuz A, Ozturk N, Korkmaz FM. Comparative effects of denture cleansers on physical properties of polyamide and polymethyl methacrylate base polymers. *Dent Mater J* 2013; 32:367-75.
9. Kumar MN, Thippeswamy HM, Swamy KN, Gujjari KA. Efficacy of commercial and household denture cleansers against *Candida albicans* adherent to acrylic denture base resin: an in vitro study. *Indian J Dent Res* 2012; 23:39-42.
10. Rutkunas V, Sabaliauskas V, Mizutani H. Effects of different food colorants and polishing techniques on color stability of provisional prosthetic materials. *Dent Mater J* 2010;29:167-76.
11. Guler AU, Yilmaz F, Kulunk T, Guler E, Kurt S. Effects of different drinks on stainability of resin composite provisional restorative materials. *J Prosthet Dent* 2005;94:118-24.
12. Patel SB, Gordan VV, Barrett AA, Barrett AA, Shen C. The effect of surface finishing and storage solutions on the color stability of resin-based composites. *J Am Dent Assoc* 2004;135:587-94.
13. Buyukyilmaz S, Ruyter IE. Color stability of denture base polymers. *Int J Prosthodont* 1994;7:372-82.
14. May KB, Razzoog ME, Koran A 3rd, Robinson E. Denture base resins: Comparison study of color stability. *J Prosthet Dent* 1992;68:78-82.
15. Lai YL, Lui HF, Lee SY. In vitro color stability, stain resistance, and water sorption of four removable gingival flange materials. *J Prosthet Dent* 2003;90:293-300.
16. Jain P, Nihill P, Sobkowski J, Agustin MZ. Commercial soft drinks: pH and in vitro dissolution of enamel. *Gen Dent* 2007;55:150-4.
17. Kuehni RG, Marcus RT. An experiment in visual scaling of small color differences. *Color Res Appl* 1979;4:83-91.
18. Ruyter IE, Nilner K, Moller B. Color stability of dental composite resin materials for crown and bridge veneers. *Dent Mater* 1987;3:246-51.
19. Hersek N, Canay S, Uzun G, Yildiz F. Color stability of denture base acrylic resins in three food colorants. *J Prosthet Dent* 1999;81:375-9.