

Comprehensive Evaluation of Effects of Various Denture Cleansers on Surface Roughness of Denture Resin: An Original Research Study

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Abstract

Background: This study was designed to comprehensively evaluate the effects of three commercially available denture cleansers tablets on surface roughness of denture resin using surface analyzer. **Materials and Methods:** In this *in vitro* study, a total of 84 samples were fabricated from heat cure acrylic resin. Acrylic samples were fabricated from wax patterns of square shape with predetermined dimension. Custom-made metallic jig was used for it. All 84 samples were divided into four groups of 21 each. Group 1 samples were kept as control. Group 2–Group 4 samples were immersed into three commercially available denture cleansers. These were Efferdent, Polident, and Secure. All samples were kept into the respective solutions. Surface analyzer was used to evaluate the surface roughness of denture resin. Data were tabulated and sent for basic statistical analysis. $P < 0.05$ was considered statistically significant ($P < 0.05$). **Results:** Statistical analysis was done by statistical software Statistical Package for the Social Sciences. The resultant data were sent to suitable statistical tests to achieve P values, mean, standard deviation, standard error, and 95% confidence interval. $P \leq 0.05$ was considered as statistically significant. Maximum mean surface roughness was noticed with Secure Cleansing Tablets. Minimum mean surface roughness was noticed with Polident Antibacterial Denture Cleanser. Control group showed insignificant surface roughness. **Conclusion:** Within the limitations of the study, authors concluded that maximum surface roughness was noticed with Secure Tablets while minimum surface roughness was observed with Polident Tablets. Efferdent Tablets showed average surface roughness on acrylic resin samples.

Keywords: Surface roughness, Denture cleansers, Surface analyzer, Vernier caliper

INTRODUCTION

Maintenance of optimal oral hygiene in complete denture wearers is very imperative as its failure can pose severe complications of oral tissues. In Indian scenario, majority of edentulous patients utilize normal tap water with or without tooth paste to maintain denture hygiene.^[1,2] However, commercial denture cleansers claim to reduce the bacterial activity up to zero. Optimal denture hygiene is very importance as dentures are worn by the patients all over the day. Optimal denture hygiene is very important as dentures are worn by the patients all over the day during which it is in close contact with oral milieu including different bacterial and fungal colonies. Furthermore, the ultimate microbial load of the denture is accountable for increased prevalence of oral health issues such as denture sore mouth and chronic atrophic candidiasis. Commercially available denture cleansers are designed to have

antimicrobial activity.^[3,4] They also act by inhibiting plaque formation and progression. Chemically, the denture cleansers are alkaline peroxides percarbonate or alkaline peroxides perborate, alkaline hypochlorites, dilute organic or inorganic acids, and enzymes.^[5,6] Denture cleansers have additional properties of reducing bad breath and denture stains. Studies have shown that their long-term usage leads to topographical surface changes on denture resins which can act as plaque

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Received: May 28, 2021; **Accepted:** Jun 30, 2021; **Published:** Aug 03, 2021

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How to cite this article: Khan SSMN, Masoom SN, Shukla S, Gopi A, Khan M, Satish K. Comprehensive Evaluation of Effects of Various Denture Cleansers on Surface Roughness of Denture Resin: An Original Research Study. J Res Adv Dent 2021;12(5):1-195.

Access this article online

Website:
www.jrad.co.in

DOI:
<https://doi.org/10.53064/jrad.2021.12.5.44>

reservoir later on. These activities can produce permanent changes in the physical properties of acrylic resin and eventually leading to fracture also.^[7,8] Denture cleansers have their own importance in maintaining denture hygiene and related oral health. Mostly, they are available in the form of tablets. In Indian scenario, most of the denture wearers are still unaware of the benefits of using denture cleansers. Long-term usage of denture cleansers usually creates surface roughness of different intensities on acrylic resins. These surface irregularities may pose deleterious microbial activity in acrylic and other issues. It is, therefore, very imperative to explore these processes as they directly affect the longevity of denture. This study was attempted to systematically evaluate the effects of three commercially available denture cleansers tablets on surface roughness of denture resin using surface analyzer.

MATERIALS AND METHODS

This study was designed, abstracted, and executed in the department of prosthodontics of the institute. The study was complete on *in vitro* model. A total of 84 samples were fabricated from heat cure acrylic resin (Lucitone 199, Dentsply Sirona Prosthetics, Pennsylvania, USA). Acrylic samples were obtained from wax patterns of square shape with side of 15 mm and thickness of 3 mm. Dimensional standardization of all patterns was completed using custom-made metallic jig. Petroleum jelly was placed evenly on the internal surface of mold space in jig. Molten modeling wax was filled into these spaces. The hardened wax blocks were obtained from the mold and utilized to construct acrylic resin samples. Digital Vernier caliper was used to cross check the dimension. All patterns were fabricated and processed in the set of three (total 28 set of flasking). For all samples, standard denture processing protocols were ensured utilizing compression molding technique. The acrylic resin in the dough stage was manipulated carefully and packed in the mold space. Trial closure was attempted and excess acrylic resin was removed. The flask was closed under controlled pressure in a bench press and bench cured for minimum 60 min at room temperature. Short curing cycle was used for all samples. First, all samples were trimmed using fine grade tungsten carbide bur. Later, all samples were polished using polishing cake. Samples were arranged in logical manner and numbered for the ease of study. All 84 samples were divided into four groups of 21 each. Group 1 samples were kept as control (immersed into tap water). Group 2–Group 4 samples were immersed into three commercially available denture cleansers. These were Efferdent (Prestige Consumer Healthcare Inc. Lynchburg, VA), Polident (GSK Health Partner, Mumbai, India), and Secure Sodium Perborate Monohydrate (Group Pharmaceuticals Ltd, Thane, India), respectively. Tablet form of all these denture cleansers was used. For immersion purpose, cleansing solutions were prepared by adding tablets as per manufacturer's instruction. All samples were kept into the respective solutions for 7 h to simulate the overnight immersion of the denture by the patient. Surface analyzer (SR160 Surface Roughness Tester, The L.S. Starrett Company, Athol, MA, USA) was used to evaluate the

surface roughness of denture resin. Total three values of surface roughness were recorded for each sample at the same spot, and an arithmetic mean value was taken as final. Results thus received were compiled in table and subjected to basic statistical analysis. $P < 0.05$ was considered statistically significant ($P < 0.05$).

RESULTS

In the present study, all noticeable findings and data were gathered in logical manner. Compiled data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The processed data were subjected to suitable statistical tests to obtain P values, mean, standard deviation, Chi-square test, standard error, and 95% confidence interval. Table 1 shows distribution of cleansing agent in groups. Table 2 is depicting basic statistical representation for Groups I–IV along with mean surface roughness in μm . Maximum mean surface roughness was noticed with Secure Cleansing Tablets. Minimum mean surface roughness was noticed with Polident Antibacterial Denture Cleanser. Control group showed insignificant surface roughness. Table 3 demonstrates level of significance evaluation by Pearson Chi-square test (for group I to IV). P value was highly significant for Group III and Group IV. Table 4 depicts the comparison of mean bone losses among the four study groups using one-way ANOVA (for all studied group). Level of significance evaluation (P value) was highly significant (0.001).

Table 1: Allocation of cleansing agent in groups

Group	Cleansing agent	<i>n</i>
I	Tap water (control)	21
II	Efferdent	21
III	Polident	21
IV	Secure	21
Total	-	84

Table 2: Fundamental statistical representation (for Groups I–IV: Mean surface roughness in μm)

Group	Mean (surface roughness) in μm	Std. deviation	Std. error	95% CI
I	0.01	0.928	0.625	1.02
II	0.17	0.302	0.329	1.72
III	0.12	0.526	0.909	1.08
IV	0.29	0.932	0.242	1.92

Table 3: Level of significance evaluation by Pearson Chi-square test (for Groups I–IV)

Group	Pearson Chi-square value	df	Level of significance (P value)
I	1.702	2.0	0.90
II	1.237	2.0	0.10
III	2.782	1.0	0.01*
IV	1.434	1.0	0.02*

* $P < 0.05$ statistically significant

Table 4: Comparison of mean surface roughness among the four study groups using one-way ANOVA (for Groups I, II, III, and IV)

Parameters	Degree of freedom	Sum of squares Σ	Mean sum of squares $m\Sigma$	F	Level of significance (P value)
Between groups	4	4.845	1.033	3.460	0.001*
Within groups	38	19.049	0.342		-
Cumulative	431.87	21.526			

* $P < 0.05$ statistically significant

DISCUSSION

The maintenance of the oral hygiene in edentulous patients is very problematic. It necessitates special attention care failing which biofilm is created on dentures. These pellicles like layers can easily leads to denture related problems such as denture stomatitis, halitosis, pulmonary infections, bacterial endocarditis, and gastric issues. All over the world, commercially available denture cleansers are the most common method of denture cleaning by comical agents. Literature has also well shown numerous studies quoting benefits of denture cleansers.^[9,10] Ideal denture cleansing agent must offer maximum antimicrobial activity along with no changes in the physical properties of acrylic resin. In intraoral environment, fungal colonies of *Candida* species are the most frequent inhabitant identified regularly. During function, food elements are usually stuck in between the tissue surface of prosthesis and oral mucous membrane. These eating substances act as favorable reservoir for microbial growth and development. In the long run, these deleterious activities often result into soft-tissue abuse. These issues are more commonly seen in old age peoples due to lack of inspiration and related awareness about oral health. Denture cleansers induce undue rough surfaces that attract plaque and microbial multiplications. Elias and associates noticed that denture surface can be trimmed and polished by rotary high-speed burs, sandpapers, waterproof sandpaper, pumice, and low abrasive liquids. These procedures also induce surface roughness same as denture cleansers.^[11] Rifaiy studied the result of mechanical polishing methods on the surface irregularity of heat cure acrylic resins. They concluded that mechanical polishing is more effective than chemical polishing.^[12] Samim and colleagues studied the effectiveness of microwave in sanitization of complete dentures. However, their study did not get much popularity due to its impracticality.^[13] Giampaolo and coworkers identified that mechanical plaque control by brush can also enhance surface unevenness for denture resin.^[14] Gulabani confirmed that the use of commercial denture cleansers diminishes the bacterial colony count as compared to plain manual cleansing methods in complete dentures.^[15] Venezian and colleagues demonstrated the numeral correlation of denture surface roughness and bacterial expansion. They stated that with every 0.2 μm increase in surface roughness, microbial multiplication

amplified by 4 times.^[16] Similar interpretations were drawn by Sharma and associates also.^[17]

CONCLUSION

Authors have drawn few very noteworthy conclusions from this study. Maximum surface roughness was noticed with Secure Tablets while minimum surface roughness was observed with Polident Tablets. Efferdent Tablets showed average surface roughness on acrylic resin samples. Comparison of mean surface roughness among the four study groups using one-way ANOVA also revealed highly significant P values. All three studied denture cleansers have shown surface roughness well within the acceptable limits; however, Polident Tablets can be sensibly used in majority of the patients. Our study outcomes must be treated as suggestive while clinical decision-making. Nevertheless, authors expect few other genuine studies to be conducted with larger sample size and wider parameters.

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