



The effect of denture cleansers on surface roughness and microhardness of stained light cured denture base material

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Abstract

Denture cleanser is the most widely used method by the patients to maintain clean and healthy denture but the prolong use of such cleansers may affect the properties of the denture. So the aim of our study is to observe the effect of denture cleansers on surface hardness and surface roughness of the light cured acrylic resin after their immersion in the tea solution.

Light curing acrylic resin was prepared and immersed in four types of denture Cleansers after there staining with tea then surface hardness and surface roughness of the acrylic resin was measured.

There is no change in the stained acrylic properties when the samples were immersed in the denture cleansers compared to that immersed in the distilled water.

The prepared denture cleanser solutions are good and satisfactory cleanser materials for the acrylic resin denture base. It's recommended to use the denture cleanser for cleansing the prostheses which cured by light curing method.

Key words: denture cleanser, surface hardness, surface roughness, light cured resin.

Introduction

The microporous surface of an acrylic denture provides a wide range of environment to support microorganisms that can threaten the health of the patient. The maintenance of clean denture prostheses is important for the health of patient, to maintain an esthetic, odor free prosthesis⁽¹⁾, and to reduce the number of the microorganisms on the dentures⁽²⁾. Denture cleansers are considered the popular method used by denture wearers for cleaning of their prosthesis⁽³⁾. The immersion cleansers are preferred by patients because they are

easy to prepare and effective in removing deposits if used regularly. However, if not used according to the manufacturer's instruction they may cause deterioration (Bleaching) of acrylic resin or corrosion of metal^(4,5).

The visible light cure resin (VLCR) had been introduced to the dental market in 1983. It's suitable for many prosthodontics applications; this system consists of special resin and curing unit which emits high intensity light in the shorter blue wave length. It's marketed under the trade name "Triad"^(6,7,8). The interest in VLCR has been increased due to ease of

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fabrication, ease of manipulation, complete denture can be made in a few hours, processing errors inherent in flasking and heat curing are eliminated also elimination of traditional mixing, flasking, deflasking and finishing procedure⁽⁸⁾. Ogle et al. found that the VLCR was not toxic, biocompatible, have close physical properties compared to the conventional heat cured resin⁽⁹⁾. On the other hand Ishigami and others showed that VLCR has inferior mechanical properties as compared to PMMA denture base material⁽¹⁰⁾. However, other authors found that the VLCR appeared to be harder and more rigid but with low impact resistance in comparison with other conventional denture base materials⁽¹¹⁾.

This study evaluated the effects of prepared denture cleanser solution (4% Oxalic acid, 4% tartaric acid and 4% citric acid) in addition to alkaline peroxide solution on the surface hardness and surface roughness of stained acrylic resin material that cured by light curing method.

Materials and methods

A sheet of the visible light activated acrylic (palatray, ^RXL) was adapted on the mold which has the dimension of (30 x 15 x 2.5) mm length, width, thickness respectively to use to measure surface roughness and indentation hardness test. We put the acrylic in the UVL curing unit for curing for 4 min [For each test 25 Specimens was prepared (5 samples for each group)].

Sample grouping

The specimen grouping was classified as follows:

Group 1: Specimens immersed in 4% citric acid denture cleanser solution.

Group 2: Specimens immersed in 4% tartaric acid denture cleanser solution.

Group 3: Specimens immersed in 4% oxalic acid denture cleanser solution.

Group 4: Specimens immersed in alkaline peroxide denture cleanser solution.

Group 5: Specimen immersed in distilled water (control group).

Preparation of the solutions

1. Tea solution: 4 grams of dry tea boiled in 500 ml of distilled water for 4 minutes, and allowed to cool at room temperature, and then the solution was decanted from tea leaves⁽¹²⁾.

2. Alkaline peroxide solution: It's prepared according to the manufacturers' instructions {1 tablet of alkaline peroxide added to 150 ml of warm distilled water (50°C)}.

3. The experimental denture cleanser solutions: a fresh denture cleanser solutions was prepared by dissolving each of the oxalic acid, tartaric acid and citric acid in the isopropyl alcohol (the isopropyl alcohol was chosen as solvent to the acid powder due to its antiseptic effect)^(13,14) as followed:

4 gm of acid powder + 100 ml. of isopropyl alcohol → 4% W/V of acid denture cleanser solution

Then, prior to the use each prepared denture cleanser, solutions were diluted with an equivalent volume of distilled water as follow:-

50 ml. of distilled water + 50 ml. of prepared denture cleanser solutions → 100 ml. of fresh diluted denture cleanser solution

Indentation hardness test

The value of surface hardness of the samples was recorded after immersion of the samples of group (1, 2, 3, 4) in the tea solutions for (24 h.) followed by immersion in the denture cleanser solution (each samples in their specific groups as described previously) for 7 days period (10 minutes every day); while the control group immersed only in the distilled

water for 8 days period. Shore hardness tester was used for measuring the indentation hardness of the specimens. The load was set to 50N which is suitable for acrylic resin material. The contact surface of the shore hardness tester must be parallel to the specimen support of the test stand to prevent error in measurements. A distance of 5-12 mm was set between the specimen surface and the indenter of the hardness tester. The contact period between the specimen and the indenter is 6 seconds after that the measurements were taken directly from the scale reading. Five measurements were done on different areas of each specimen and averages of five readings were calculated.

Surface roughness test

The Profilometer device (surface roughness test) was used In order to study the effect of the denture cleansing solution on the microgeometry of the test surface. This device is supplied with a surface analyzer (Sharp stylus) to trace the profile of the surface irregularities and recording all the peaks and recess which characterize the surface. (The surface roughness were recorded and determined before and after immersion in the denture cleansing solution and distilled water).

After recording the value of surface roughness, all the samples except group 5 were immersed in the tea solution for (24 h.). They were then immersed in the denture cleanser solution (each samples in there specific groups as described previously) for 7 days period (10 minutes every day) while group 5 samples were immersed only in distilled water for 7 days period. Then after that a second reading of surface roughness was obtained and considered as after immersion value and The difference

between the two reading (before and after immersion) were determined and calculated.

In the analysis we used Descriptive statistics (Arithmetic mean, Standard deviation, Standard of error, Statistical tables) and inferential statistics [one way analysis of variance test (ANOVA)].

Results

Five reading for each specimens tested were taken from Shore hardness tester to determine the indentation hardness of the acrylic resin material. The mean and the standard deviation of these reading are listed in table (1), Figure (1).The results of this test indicated that the oxalic acid have the highest mean value of indentation resistance followed by Tartaric acid, alkaline peroxide then the citric acid while the distilled water show the lowest hardness resistance. One way analysis of variance test (ANOVA) revealed a statistically no significant difference between the five groups table (2).

the mean and the standard deviation of the surface roughness for the experimental denture cleansers are shown in table (3), Figure (2).the result show that surface roughness means for the samples that immersed in the denture cleanser solution is nearly to the mean of the samples that immersed in the distilled water Statistically there was no significant difference between the groups as reveal by applying the (ANOVA) test.

Discussion

Hardness is a term used to describe the resistance of Indentation as distinct from resistance to wear or scratching⁽¹⁵⁾. Concerning the results of the present study a statistical analysis showed a non-significant difference

among the tested samples that immersed in the denture cleansers compared to that immersed in the distilled water; No reports were found in the available literature using the prepared denture cleanser solutions that might allow a direct comparison with this study, nevertheless the results of the hardness test of the samples that immersed in the prepared denture cleansers are comparable with those of Al-khafaji 2004 when she used the same prepared denture cleanser solution but the type of acrylic was cured by the water bath curing method and by the using of the microwave energy and she found that there was non-significant difference among the tested samples that immersed in the denture cleansers compared to that immersed in the distilled water⁽¹⁴⁾. The absence of any effect of the immersion solutions on the surface hardness of acrylic resin could be due to the presence of the cross linking material which reduces the denture bases solubility to organic solvents, this is in agreement with those done by an earlier studies^(9,16-21) while Jagger and Hugget found that the cross linking agents produce no increase in surface hardness below the rubber transition temperature⁽²²⁾. On the other hand our results disagrees with others previous studies who found that the complete polymerization of the acrylic surface mass probably led to acceptable value of surface hardness could be another reason of absence of the effect of immersion solutions on the surface hardness of acrylic resin.⁽²³⁻²⁶⁾

The samples that immersed in distilled water have least mean value compared to that immersed in the prepared denture cleansers solutions. This could be due to that water either combines with or more probably enters into the amorphous outer layer and it suggests to form a chemical interaction

which can't be prevented so it exerts a plasticizing or softening effect.⁽²⁷⁾

The result of the surface roughness of the acrylic resin showed that light acrylic resin samples have no significant difference when the samples immersed in the different denture cleanser solutions compared with the samples that immersed in distilled water. These results agree with the results obtained by Hatim et al. when they used the same denture cleanser solutions; they showed that even when the samples immersed for 1 year in the solutions the acrylic surface smoothness will not be effected⁽¹³⁾ also Al-Dabagi show that the surface of the heat cured acrylic resin will not be effected when immersed in different denture cleanser solutions⁽²⁸⁾. Similarly Ma et al. obtained the same results that the disinfectant solutions had no damaging effect on the surface of the acrylic resin.^(29, 30) Finally alkafaji also used the same denture cleanser solution, and found that no significant difference when the samples immersed in the different denture cleanser solutions compared with the samples that were immersed in the distilled water⁽¹³⁾.

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Table (1)-Descriptive statistics and t-test of Indentation hardness test

Denture cleanser	N	Mean	S.D.	S. E.
Citric acid	5	40.05	1.58	4.28
Tartaric acid	5	40.40	1.625	7.26
Oxalic acid	5	44.70	1.174	5.25
Alkaline peroxide	5	40.38	1.033	4.62
Distilled water	5	40.02	1.057	4.72

Table (2)- ANOVA test of the hardness test between the 5 groups

	Sum of squares	Df	Mean squares	F	Sig.
Between groups	236.724	4	59.181	0.415	0.796
Within groups	2850.436	20	142.522		
Total	3087.160	24			

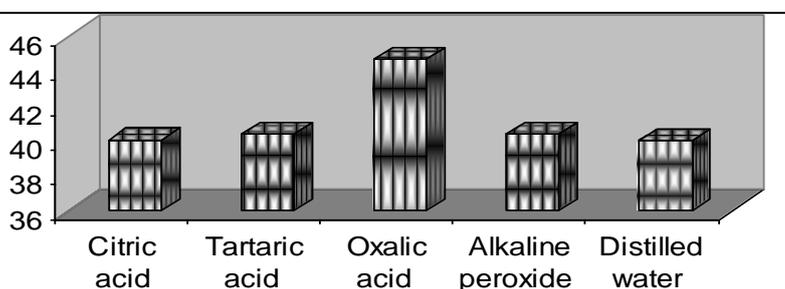


Figure (1): Histogram of Indentation hardness test

Table (3)-Descriptive statistics and t-test of Roughness test (µm)

Denture cleanser	N	Mean	S.D.	S. E.
Citric acid	5	-.003	.001	.0008
Tartaric acid	5	0	.002	.001
Oxalic acid	5	-0	.006	.002
Alkaline peroxide	5	-.001	.029	.001
Distilled water	5	0	0	0

Table (4)- ANOVA test of the surface roughness between the 5 groups

	Sum of squares	Df	Mean squares	F	Sig.
Between groups	.00	4	.0	0.715	0.591
Within groups	.00	20	.0		
Total	.00	24			

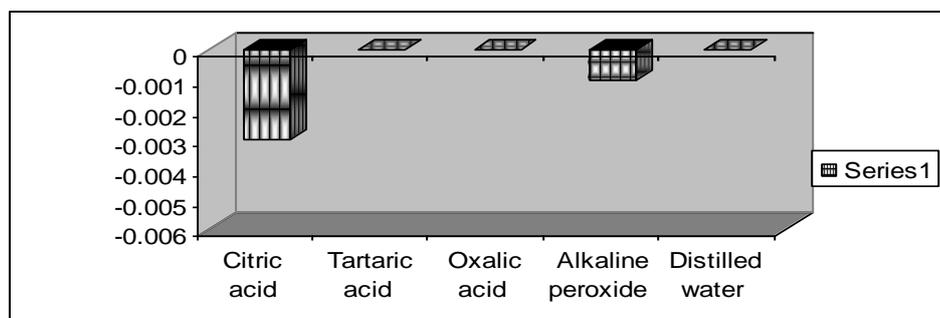


Figure (2): Histogram of Roughness test