

The effect of denture cleaners on Tensile Strength and Indentation hardness of denture base materials

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Abstract

Background: Denture cleaner solutions are used extensively for the cleaning of prosthesis both plastic and metallic component. The chemical composition of cleaner solution are virtually important in defining their adverse effect on properties of acrylic part of prosthesis

Aims of the study The present study carried out to study the effect of some cleaning solution on tensile strength and indentation hardness of both types of acrylic resin (hot and cold cured) and compare the effect on different types of denture materials.

Materials and methods: Specimens of hot and cold cured acrylic resin were prepared according to ADA specification for both indentation hardness and tensile strength test. The specimen were immersed in distilled water for seven days then were left in containers containing one of the following denture cleaners, Staradent 1% H₂O₂, 5% HCL & vinegar solution. Each container contained five specimens of either heat cure or cold cure with one type of denture cleaners and they were left for seven days. Specimens were then tested for indentation hardness and tensile strength test.

Results: The results showed that Vinegar solution has an deleterious effect on tensile strength and indentation surface hardness of hot cured acrylic resin as compared with control while for cold cure all specimens affected by all cleaning solutions.

Key ward: Denture cleaners, tensile strength, indentation hardness

Introduction

Denture cleanliness is essential to prevent malodour, poor aesthetic and the accumulation of plaque and calculus effect on mucosa 1,2,3. Clean denture surfaces must be done efficiently because the fungi grow on denture surface infect and reinfect soft tissue.(4_11). Knowledge of constituents of denture cleaners, their efficiency, adverse effect and safety would aid in dispensing appropriate information to the patients (12). Prolong use of such denture cleaner may affect the fit of the denture and rough surface produced makes the maintenance of clean surface most difficult, the patient should be warned accordingly.(13)

Several studies were carried out to study the effect of denture cleaners (disinfectant) on acrylic Resin. Surface roughness and Transverse deflection testes were made to study the effect of cleaners. (14_16)

The present study was carried out to study the change in tensile strength and indentation hardness after immersion in one type of denture cleaner [Staradent tablet, 1% Hydrogen peroxide, 5% Hydrochloric acid and Vinegar] and the difference between two types of acrylic resin in respect to the properties after immersion.

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Materials and Methods

Indentation hardness test

Rectangular wax plate (65x55x3mm) was used for the preparation of a mould for both types of acrylic resin (hot & cold cure)*. The wax plate was fixed into the lower half of the flask. Then stone was poured in the lower half of flask, and then the stone in the lower half of flask was left to harden so the level of wax plate was kept with the level of stone. After complete setting of the stone wax elimination was done and was coated with separating medium, then the surface of mould was ready for packing the acrylic dough. The manufacturer instructions were followed for packing and curing of both type of acrylic resin as explained in Table -1

After complete processing of acrylic resin the cured plate of both types of acrylic resin were hand finished for one surface using ray wheel with continuous water cooling, the specimen were then polished using rag wheel with pumice in dental lathe for two minutes, A wet soft mop on dental lathe was used at low speed (15 rpm) with continues water cooling to avoid over heating of specimen. Each plate of acrylic resin was finished to obtain the final measurements of (65x50x2.5 -0.03 mm) length, width, & depth respectively. These measurements were done using Micrometer Starreit Company, Massussets USA. The specimens were tested for indentation hardness for both heat and cold cure acrylic resin after being conditioned in distilled water at room temperature for one week in order to reach nearly a state of saturation. Specimens were left in a container containing one of the following denture cleaners, Staradent

tablet, 1%hydrogen peroxide** (H₂O₂),5%hydrochloric acid and vinegar*** for seven days .Each container contains five specimens of either heat cure or cold cure with one type of denture cleaners and left for seven days. For staradent tablet the solution needed to be changed 12hrs while for the remaining solution had to be changed every day.

The shore hardness tester **** was used in this study for measuring the indentation hard ness of the specimen .The test load was set to 50N for Shore (D) Which is suitable for acrylic resin materials. In order to prevent errors in measurement the contact surface of the shore hardness tester must be parallel to specimen support of the stand before carrying out the test ,A distant of 5-12mm was set between the specimen surface and the indenter of the hardness tester , The contact period between the specimen and the indenter was 6 second. The measurement was then taken directly from the scale reading. Five measurements were obtained from different areas of each specimen and an average reading was calculated.

Tensile strength test

Fifty Dumbbell-shaped specimens were prepared by cutting wax blocks fixed on a glass plates according to the ready made Dumbbell-shaped wax block. The measurements were done using Micrometer starett at different area to be sure that the same width was duplicated from plastic specimen. The flasking and curing process were preceded as described in table (1) and specimens were finished as prescribed previously in the indentation hardness test. The specimens were tested on an

* Heat & cold cure Qualy Dental Ltd., Dentor House Dominion Way West Sussex BNI 480Nengland.

** H₂O₂ Original concentration 6% ,Iraq Pharmaceutical Industry Co.

*** Al-Badawe Industry

**** Instron Universal Testing Machine , Model 1190,Limited concentration Rd.,High Wycombe Backs ,U K

instron*** testing machine set at cross head speed 10 mm/min in 100mm chart speed. The load cell used was tensile load cell maximum capacity 100kn. The tensile strength is calculated by the following equation:

$$T.S = F/A$$

$$F = \text{force (N) and } A = \text{Area (mm)}^2$$

Note: The final measurements of the specimen for both tests (surface indentation & tensile strength test) were made according to the ADA specification⁽¹⁷⁾

Note: the specimens were tested for tensile strength test after treatment with denture cleaner in a manner similar to the indentation hardness test

Results

Tensile strength

Table (2) showed the mean values, standard deviation (S.D) and coefficient of variance of the tested specimens of heat and cold acrylic resin and it appeared that the lowest mean value of tensile strength observed were those specimen immersed in vinegar solution as compared with the control.

Indentation hardness test

Table (3) showed the mean values, standard deviation (S.D) and coefficient of variance of the tested specimens of heat and cold cured acrylic resin and it appeared that the lowest mean values of indentation hardness was observed with the specimens immersed in vinegar solution as compared with the control.

The effect of cleaning solution on tensile strength of acrylic resin denture base material appeared in table 4. In this table a non significant different effect of all cleaning solutions on heat cure acrylic resin as compared with the control except vinegar solution had a significant different effect. While for cold cure acrylic resin, all solutions showed a highly different effect.

Regarding the effect on indentation hardness table 4 showed that only vinegar solution showed a significant different effect on heat cure acrylic resin, while the effect on cold cure showed significant and highly significant different as compared with the control

Discussion

Denture cleaning solution have been routinely used for maintains of clean and sterile denture without damaging the base material. This study was conducted to evaluate the effect of some solution of denture cleaners for seven days immersion time which is a relatively long period to know the worst behavior and the possible effect that may take place on repeated short immersions of dental prostheses on denture cleaners. The result of the present study showed that only vinegar solution had an undesirable effect on both tensile strength and indentation hardness, This deleterious effect on both tests might be due to the high acidity of vinegar solution that causes a reduction in tensile strength and surface hardness of acrylic resin This result was similar to the result obtained by Jassim 2001⁽¹⁶⁾ which revealed that vinegar solution affects the transverse strength but still within the ADA specification No.12⁽¹⁷⁾

Regarding the effect of cleaning solution on cold cure acrylic specimens ,it was appeared that cold cure acrylic resin affected by all cleaning solution .This might be due to the high amount of residual monomer present in the cold cure acrylic resin, This result was similar to the result obtained by Faraj and Jassim2000⁽¹⁵⁾, Jassim 2001⁽¹⁶⁾ and Faraj 1977⁽¹⁸⁾ who studied the effect of HCL on surface of heat cure acrylic resin materials after 12 hrs, These findings may be due to that those studies were done using

SEM and photograph, while the results of the effect of disinfectant solutions on the hardness of acrylic resin denture teeth showed that non of the following solutions (4% chlorhexidine, 1% sodium hypochlorite and 3.78% sodium perborate) on acrylic denture teeth⁽¹⁹⁾. On the other hand the result obtained by Asad et al⁽²⁰⁾ showed that various disinfection solutions (0.5% chlorhexidine, 2% glteraldehyde and alcohol) did not affect the surface hardness of acrylic denture base materials.

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Table-1-The manufacturer instruction of packing and curing of heat cure and cold cure acrylic resin

Materials	QD Qualy heat cure	QD Qualy cold cure
Powder/Liquid	2.5/1 (weight)	2.1/1 (Volume)
Dough Time	15min	5min
Working Time	15min	15min
Room Temperature	(23C+5)	(23C+5)
Curing Time	Immersed the flask in boiling water and allow to regain boiling temperature and cure for 20 minutes	Leave flask under clamp pressure an over night period

Table-2- Effect of cleaning solution on Tensile strength of acrylic resin denture base materials

COLD CURE				HEAT CURE		
Solutions	Mean	S.D	C.V%	Mean	S.D	C.V%
Control	63.46	7.4	11.5	52.6	4.4	8.3
Staradent	58.53	5.93	10.1	52.78	2.9	5.4
1%H2O2	59.33	5.62	9.4	52.47	4.8	9.1
5%HCl	55.58	6.05	10.8	51.06	4.4	8.6
Vinegar	52.03	5.03	9.6	43.67	3.7	8.4

S.D= standard deviation , C.V= coefficient of variance

Table -3 - Effect of cleaning solution on Indentation Hardness of acrylic denture base materials

Heat cure				Cold cure		
Solutions	Mean	S.D	C.V%	Means	S.D	C.V%
Control	85.6	1.55	1.8	88.1	2.08	2.36
Staradent	82.2	0.89	1.0	88.8	0.68	0.7
1%H2O2	82.2	1.13	1.3	88.5	8.39	9.4
5%HCl	79.2	0.67	0.8	87.6	11.9	13.5
Vinegar	75.9	1.14	1.5	70.9	5.0	7.1

S.D= standard deviation , C.V= coefficient of variance

Table-4- ANOVA Test for the significant different between group of denture cleaners for heat and cold cure

Tensile strength		
Solution	Heat cure	Cold cure
Staradent +control	N	S**
1%H2O2+control	N	S**
5%HCL+control	N	HS****
Vinegar +control	S**	HS****
Indentation hardness		
Solutions	Heat cure	Cold cure
Staradent +control	N	S**
1%H2O2+control	N	S**
5%HCL+control	N	HS****
Vinegar +control	HS***	HS****

*One star indicate significant different

**Two star and more indicate significant different between group and increase in number star means increase in significant different