

Evaluation of the Effect of Some Denture Cleansers on Hardness of Acrylic Denture Base and Teeth Materials

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ABSTRACT

Aims: To evaluate the effect of some commercially available new denture cleansers on the hardness of acrylic denture base and teeth materials. **Materials and method:** Samples were prepared from heat cured acrylic resin denture base material and teeth. After that, half of the samples for each group were immersed for ½ hr per day in the denture cleanser throughout one month, the other half of the samples immersed for 8 hr per day in the denture cleanser through one month. The denture cleansers used are three solutions prepared freshly everyday for immersion of the samples. The hardness of the samples were tested by using Vickers hardness tester, the mean is taken for each group and evaluated by using one way analysis of variance test and Duncan's multiple range test to compare the groups. **Results:** The results demonstrated that there were significant differences in the hardness of acrylic resin denture base material with different denture cleansers and duration of immersion ($P < 0.0001$), and there were significant differences in the hardness of acrylic resin teeth with different denture cleansers and duration of immersion ($P < 0.0001$). The results also revealed that the cross linked teeth had a higher hardness value than the acrylic resin teeth. **Conclusions:** The type of denture cleanser and duration of immersion had an effect on the surface hardness of acrylic resin teeth and denture base materials. The cross linking of acrylic resin materials increase the resistance of the material to the action of solvents.

Key words: Denture cleanser, Surface hardness, Acrylic resin.

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INTRODUCTION

Acrylic resin is the most employed material in the construction of removable complete and partial denture and teeth materials. Prosthesis have been identified as a source of cross contamination between patient and dental personnel⁽¹⁻⁵⁾.

Denture base materials and denture teeth collected the deposits in the same manner as natural teeth. Chemical disinfectant is a practical easy and satisfactory method to prevent cross contamination between patient and dental staff^(4, 6). In choosing a disinfectant for dental prosthesis, consideration should be given to its compatibility with the

type of material to be disinfected to avoid adverse effects^(2, 7-9).

Many materials have been used as denture cleansers such as glutaraldehyde, chlorhexidine, sodium hypochloride, ethanol, and sodium perborate. These materials have different effects on the properties of acrylic resin^(2, 3, 8). Some new denture cleansers are studied such as vinegar, sodium bicarbonate and alum, sodium bicarbonate and citric acid, and saturated solution of sodium chloride⁽¹⁰⁾.

The aim of this study is to evaluate the effect of some commercially available new denture cleansers on the hardness of acrylic denture base and teeth materials.

MATERIALS AND METHODS

Thirty five samples were prepared from heat cured acrylic resin denture base material (Major heat cured acrylic resin / Italy) and seventy samples were prepared from acrylic

resin teeth (AL-Noor acrylic resin teeth / Iraqi & Seif cross linked acrylic teeth / Syria) the specimens were divided into groups as shown in Figure (1).

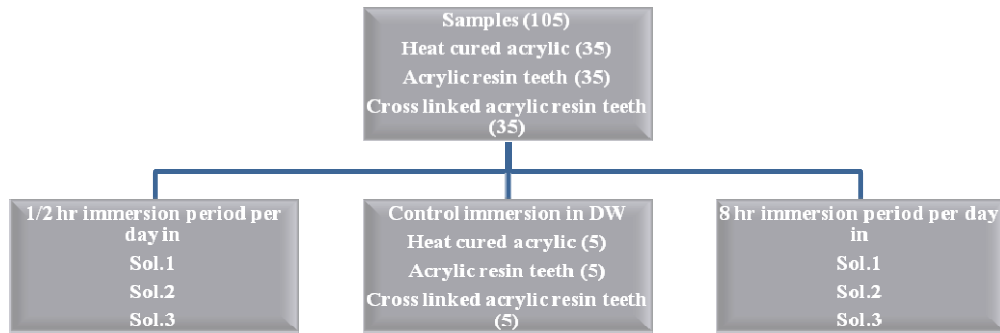


Figure (1): Experimental design of the study.

The acrylic resin samples were prepared in dimensions of (10*10*2.5) mm from heat cured acrylic resin which was proportioned and mixed according to manufacturer in-

structions, packed into mold and processed in water bath (1 hr at 74 C then ½ hr at 100 C)⁽¹¹⁾. (Figure 2).

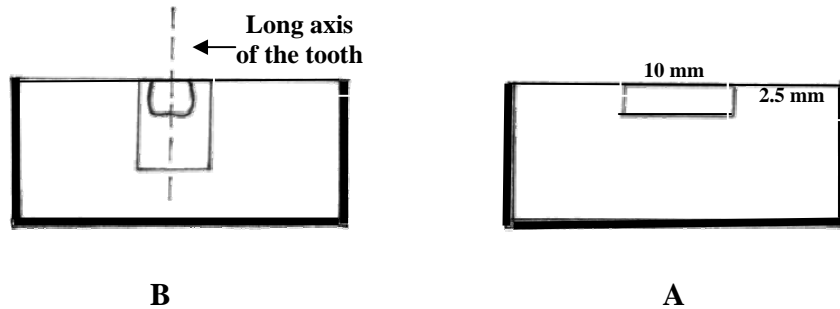


Figure 2:A- Diagram showing the acrylic resin denture base material sample.

B- Diagram showing the acrylic resin teeth

The teeth were prepared by placing each tooth in the center of polyvinylchloride tube (20*20) mm diameter and length which was previously filled with melted wax. The teeth were placed in the center of the tubes with the axial surfaces parallel to the long axis of the tubes. The tubes were then invested in the usual denture flasks in dental stone, the wax was boiled out, and the mould was

packed with denture resin, and cured. After curing, the specimens were removed and the occlusal surface of the teeth were flattened up to 1200 grit silicon carbide paper with running water as a coolant (Wolpert/Germany)^(1,3), (Figure 2).

After that half of the samples for each group were immersed for ½ hr per day in the denture cleanser throughout one month. The other half of the samples immersed for 8 hr

per day in the denture cleanser throughout one month, ⁽¹⁰⁾ excluding the control group were five samples from each material were immersed in distilled water for one month.

The denture cleansers used are three solutions prepared freshly everyday for immersion of the samples ⁽¹⁰⁾. The composition of the prepared solutions was shown in Table (1).

Table (1): The materials used in the study.

Materials	Company
1 Heat cured acrylic	Major / Italy (NIOM CE ISO 1576)
2 Acrylic resin teeth	AL-Noor / Iraq
3 Cross linked acrylic resin teeth	Seif / Syria
4 Sol.1	Sodium bicarbonate/China (7gm)+clear commercial vinegar/Jordan (5ml) in 100ml of distilled water
5 Sol.2	Sodium bicarbonate/China (2gm)+thymol oil/Iraq (3.57gm) in 100ml of distilled water
6 Sol.3	Saturated salt solution/Iraq (40gm salt) in 100ml of distilled water

At the end of the month the hardness of the samples were tested by using Vickers hardness tester (Otto Wolpert/Germany), the mean is taken for each group and evaluated by using one way analysis of variance test and Duncan's multiple range test to compare between the groups.

RESULTS

Table (2) demonstrated that there were significant differences in the hardness of

acrylic resin denture base material between different denture cleansers and duration of immersion ($P < 0.0001$). The Duncan's multiple range test showed that the 8hr of immersion in disinfectant solution per day lead to more decrease in the hardness of the samples ($16.28 \pm 0.084 - 16.58 \pm 0.084$) than 1/2 hr immersion period, except for solution (2) where there is no difference between 1/2 hr (16.26 ± 0.182) and 8 hr (16.28 ± 0.084) immersion period. (Figure 3).

Table (2): Analysis of variance (ANOVA) of the Vickers hardness number of heat cured acrylic resin samples in different denture cleansers and duration of immersion.

Source of variance	DF	Sum of square	Mean square	F- value	P - value
Denture cleanser & duration of immersion	6	15.0320	2.5053	182.68	0.000
Error	28	0.3840	0.0137		
Total	34	15.4160			

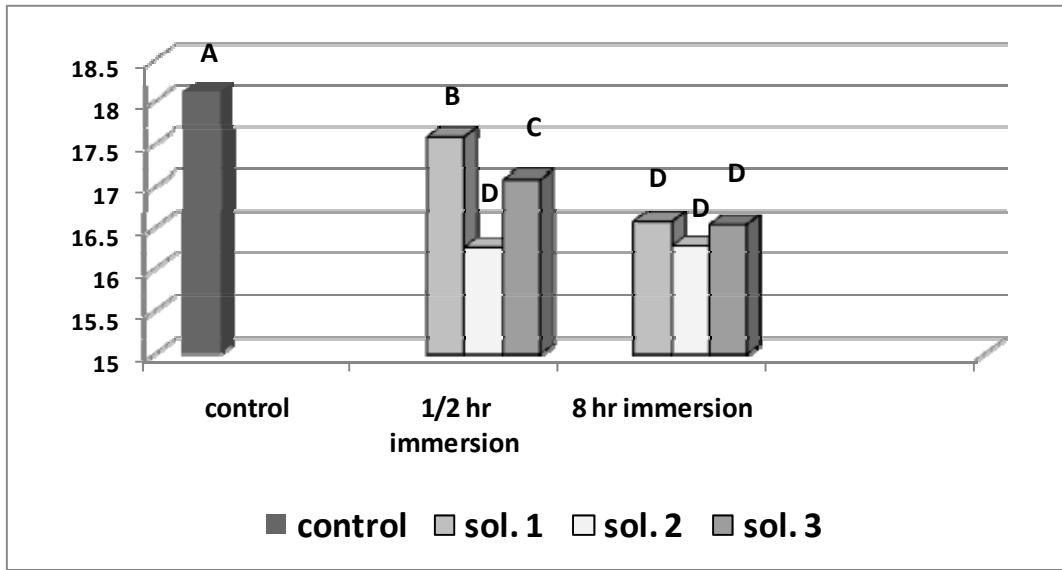


Figure (3): Duncan's multiple range test showing VHN of heat cured acrylic resin samples of control and treated groups.

Table (3) demonstrated that there were significant differences in the hardness of acrylic resin teeth between different denture cleansers and duration of immersion ($P < 0.0001$). The Duncan's multiple range test showed that the 8hr of immersion in disinfectant solution per day lead to more decrease in the hardness of the acrylic resin teeth ($14.76 \pm 0.054 - 16.86 \pm 0.054$) than the 1/2 hr immersion period ($16.10 \pm 0.141 - 18.86 \pm 0.054$). Although the disinfectant solution (2) resulted in more decrease in the

hardness of the acrylic resin teeth (16.1 ± 0.141) and the cross linked teeth (16.18 ± 0.109) at 1/2 hr immersion period per day. While the disinfectant solution (3) resulted in more decrease in the hardness of the acrylic resin teeth (14.76 ± 0.054) and the cross linked teeth (15.06 ± 0.089) at 8 hr immersion period per day, (Figure 4). The results also reveal that the cross linked teeth had a higher hardness value than the acrylic resin teeth.

Table (3): Analysis of variance (ANOVA) of the Vickers hardness number of acrylic resin teeth in different denture cleansers and duration of immersion.

Source of variance	DF	Sum of square	Mean square	F-value	P-value
Denture cleanser & duration of immersion	13	163.8510	12.6039	1482.81	0.000
Error	56	0.4760	0.0085		
Total	69	164.3270			

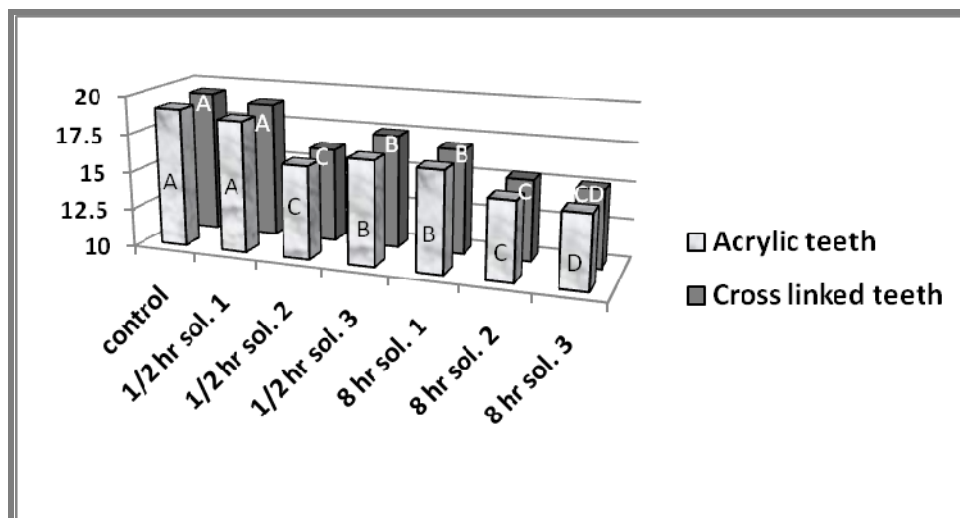


Figure (4): Duncan's multiple range test showing VHN of acrylic resin teeth & cross linked teeth samples of control and treated groups.

DISCUSSION

The results of this study showed that the hardness of the acrylic resin denture base material and acrylic resin teeth were decreased after immersion in denture cleansers. This is attributed to the plasticizing effect of water. Water, as small molecules, may act as a plasticizer following diffusion into the polymer, thus relaxing the polymer chains and subsequently lowering the hardness of the acrylic resin denture base and teeth materials,^(1, 12, 13) the decrease in hardness of the samples more than the control group could be attributed for the slow absorption of disinfecting chemicals into the resin that resulted in some structural change in the polymer⁽³⁾.

The duration of immersion and the type of denture cleanser play an important role in affecting the properties of denture base and teeth materials. The 8 hr immersion period which resemble the period the patient take off the denture during night, lead to more decrease in the hardness of the tested specimens this could be attributed to the long contact of the denture cleanser material with the surface of the resin⁽³⁾. Vinegar is considered as a strong acid solvent, this property leads to softening of the surface layer of acrylic resin material and decrease inter chain forces and this will allow the water

molecules to penetrate the material^(7,10). The thymol oil acts on the surface of the resin by its solvent action for acrylic and other thermoplastic resins⁽²⁾. The saturated solution of salt lead to more water sorption inside the acrylic because sodium chloride is an ionic compound when dissolved in water forms an end less repeating lattice of ions and due to the polar properties of resin molecules this will lead to increase water taken due to electrostatic changes, thus decrease the surface hardness of the material^(7,14,15,16,17).

The cross linked acrylic teeth subjected to less decrease in hardness than the other materials this could be explained by the fact that, the cross linking agents confers two useful properties on the cured resin. It reduces the acrylic resin solubility to organic solvents, and reduces the tendency to craze under stress.^(1,2, 3, 18, 19)

CONCLUSIONS

The type of denture cleanser and duration of immersion had an effect on the surface hardness of acrylic resin teeth and denture base materials. The 1/2 hr immersion period is preferred so as to decrease the adverse effect of denture cleansers.

The cross linking of acrylic resin materials increase resistance of the material to the action of solvents.

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