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THE EFFECT OF NEWLY PREPARED CLEANSING AGENT ON THE HARDNESS OF HIGHLY IMPACT ACRYLIC DENTURE BASE MATERIAL

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ABSTRACT: *This research study is aimed to evaluate the effect of two prepared and two commercial solutions on Hardness of high impact acrylic denture base material. The total number of specimens was seventy five. They were prepared from high impact acrylic and subdivided into five groups for each solution (EDTA, Soda+H_2O_2, Lacalut, Corega and distilled water). Indentation hardness test was applied for this research. The specimens were constructed with dimensions 30×15×3± 0.03mm (length, width, and thickness respectively) According to ADA specification number. The immersion periods in this research area (2day, 7 days and one month). ANOVA and Duncan multiple range test were used. The statistical results were considered significant at $p \leq 0.05$. The results show that there were significant differences in indentation hardness in all solution that use specially in (EDTA) and lacalute causes decrease of hardness of high impact acrylic material in (2days, 7 days, and one month). It was concluded that (EDTA) and lacalute denture cleanser have the most effect (decrease in the indentation hardness) of high impact acrylic denture base material in (2days, 7 days, and one month)*

KEYWORDS: Denture Cleanser, Hardness, Corega

INTRODUCTION

The aims of this study are to evaluate the effect of two prepared Polymethyl methacrylate (PMMA) has been used in dental prosthetic devices for almost 70 years. Three fundamental features have contributed to its success: excellent appearance, simple processing technique and easiness of the repair. However, the resistance to impact and fracture of PMMA during function are low fracture [1-3]. The denture base resin is subjected to various stresses during function. During fabrication of a denture, the physical and mechanical properties influence by cure condition and choice of materials. Each cure cycle or fabrication technique is a compromise that attempts to optimize the properties thought important for a given application. Dentist and manufacturers of denture base materials have long been searching for ideal materials and designs for dentures. So far, the results have been noteworthy, although there are still some physical and mechanical problems with these materials [4]. Many attempts have been made to enhance the strength properties of acrylic denture bases, including the addition of metal wire. The primary problem of using metal wire reinforcement is poor adhesion between wire and acrylic resin. Although several methods have been used to improve the adhesion between these components, enhancement in mechanical properties, such as transverse strength and fatigue resistance, was not significant. [5,6] Modifications of chemical structure, by the addition of cross-linking agents such as polyethylene glycol di-methacrylate or by copolymerization with rubber, have been attempted [7] Various types of fiber including carbon fiber whisker fiber, aramid fiber, polyethylene fiber, and glass fiber have been used as a reinforcement. Reinforcement with fibers enhances the mechanical strength characteristics of denture bases, such as the transverse strength, ultimate tensile strength and impact strength. In addition, fiber reinforcement has advantages compared with other reinforcement methods, including

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improved esthetics, enhanced bonding to the resin matrix, and ease of repair. [8-12] Hardness is the resistance of a material to indentation, the low hardness number of acrylic resin base material indicates that these materials may be scratched easily and abraded [13].

The hardness of denture base materials may undergo changes due to the continued polymerization and water uptake, where water absorption into denture base materials act as a plasticizer and alter their mechanical properties [14].

Cleansers and cleaning methods used may have a harmful effect on the plastic or metal component of the denture. Knowledge of the constituents of denture cleansers, their efficiency, adverse effect and safety would aid in dispensing appropriate information to the patient, so the dentist must be able to recommend a denture cleanser that is effective, non-deleterious to denture material and safe for patient use**.** [15,16]

The aims of this study are to evaluate the effect of two prepared and two commercial solutions on the indentation hardness of high impact acrylic denture base material after (2day, 7 days and 1 month).

MATERIALS AND METHODS

The total number of specimens was Seventy five prepared from high impact acrylic and subdivided into five groups for each solution. The immersion periods in this study are (2day, 7 days and one month)

High impact acrylic (vertex-dental) used in this research mixed according to the manufacturer's instruction. The liquid powder ratio is 1 ml liquid and 1.2 mg powder, adding powder to the liquid and then mixing the powder to liquid for 30 min , leave the mixing for 8 min in room temperature 22°C until reach to the dough stage adding the highly impact acrylic to the flask through in room temperature 22 °C and then press the flask by press, and putting immediately inside hot water approximately 70°C for 90 min and then rising the degree of temperature to the 100 °C for 30 min and the remove the flask and leave it to cool.one laboratory test was use for this research. The specimens were prepared with dimensions of 30×15×3± 0.03mm (length, width, and thickness respectively) as shown in figure (3.17). The specimen's surfaces were tested for hardness at three different locations, and then the mean was taken for each specimen (Issac, 1992). The test was done at Mechanical Engineering College / Mosul university by using Rockwell hardness tester (UK), equipped with an indenter in the form of round steel ball of 0.25 inch in diameter. The specimen was subjected to fixed minor load of 60 kg by weight. The Rockwell hardness inspector was calibrated according to the manufacture recommendations (60 Kg force, 0.25 inch ball, scale L special for plastic materials, RHBL.

The specimens were fabricated by using Type III model dental stone (Zhermack SPA Rovigo, Italy) as a mold. This study deals with five solutions (table 1).two experimental prepared solutions, solution one (Ethylene Diamin Tetra acetic Acid) EDTA and solution two (soda Na_2Co_3 and Hydrogen peroxide H_2O_2) two commercial denture cleanser tablets (Corega, lacalut) for comparison and distilled water as a control solution. Every solution was diluted in 100 ml of distilled water.

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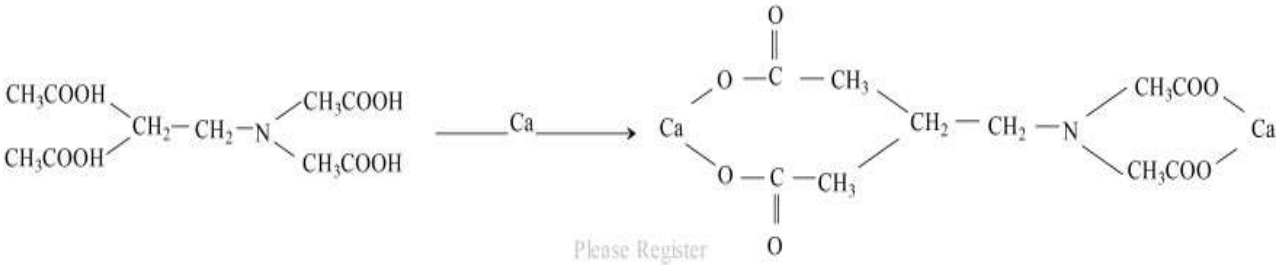
The following equations illustrate the preparation of the above solutions

1-EDTA



By mixing the following compounds in distilled water, the artificial saliva solution were prepared [17].

Compounds **Concentrations (mg/L)**

- NaCl 0.4
- KCl 0.4
- $CaCL_2$ 0.79
- NaH_2PO_4 0.78
- UREA 1
- DISTELD WATER 1 L

The fresh solutions were prepared daily at the beginning of soaking trial (1/2h). The specimens were removed from the solution, washed with distilled water, and dried in air by shaking the specimen for about 30 seconds. The solutions were removed, the beakers were cleaned and the specimens were immersed in distilled water for 8 hours at (21±2^{o}C) then immersed in artificial saliva for about 15.5 hats (37±1^{o}C) in the incubator. According to the method described previously The immersion periods in this study are (2day, 7 days and one month). [18].

Lacalut denture cleanser, release an active oxygen, and Corega denture cleanser, release an active CO2, used in this study and prepared as manufacture instruction

The following statistical methods were used to analyse and assess the results via SPSS V. 11.5 for Windows:

1. Descriptive statistics include mean ± standard deviation values.

2. ANOVA and Duncan multiple range test were used. The statistical results were considered significant at $p \leq 0.05$.

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RESULTS

The One Way Analysis of variance (ANOVA) as shown in Tables (1) demonstrated that there was a significant difference in 2 days, 7 days and 1 month at $P \leq 0.05$ in the Indentation Hardness measurement of high impact acrylic in a time interval.

Indentation Hardness Test of high impact acrylic, in comparison between time intervals, figures (1-3) demonstrated the mean ± SD values and Duncan's multiple range tests of Indentation Hardness values. In 2 days the lowest value in Soda+H_2O_2. In 7 days, the highest value of Distilled water and the lowest value in Corega. In 1 month, the highest value in EDTA.

The One Way Analysis of variance (ANOVA) as shown in Tables (2) demonstrated that there was a significant difference in (EDTA, Soda+H_2O_2, Corega, Lancelot, and distilled water) at $P \leq 0.05$ in the Indentation Hardness Test of high impact acrylic among different solutions.

Indentation Hardness Test of high impact acrylic, immersing in (EDTA, Soda+H_2O_2, Corega, Lacalute, distilled water), figure (4-8) demonstrated the mean ± SD values and Duncan's multiple range test of Indentation Hardness Test. In all solutions showed the highest value in 2 days and 7 days and the lowest value in 1 month.

DISCUSSION

Figures (1-3) and table (2) one in comparison between time at different solutions (EDTA, Soda+H_2O_2, Lancelot, Corega, and distilled water). This study demonstrated that there was a significant difference at $P > 0.05$ in the Indentation Hardness Test in (2 days, 7 days and 1 month), this is due to the difference in the chemical composition of the solutions. The results of the study were similar to a study done by Pavarina*et al* [19] who investigated the effect of disinfectant solutions on the hardness of acrylic denture teeth. It was explained that the absence of any effect of immersing solutions on the surface hardness of the acrylic denture teeth can be attributed to the cross-linking of the materials.

Figures (4-8) and Table (3) one in comparison between solutions at different times (2 days, 7 days and 1 month). This study concluded that there was a significant difference at $P > 0.05$ in the indentation hardness solutions (EDTA, Soda+H_2O_2, lacalut, Corega, and distilled water,) at different times, this due to that Acrylic resin is hydrophilic and is subject to water sorption and which acts as plasticizer and softened the highly impact acrylic responsible for the decrease in hardness due to the formation of cracking zones resulting from the absorption and adsorption cycles, in addition to the hydrolytic degradation and gradual deterioration of its infrastructure over time. This result is in agreement with Rahawi[20] who found that the all conventional materials are susceptible to the effect of aqueous media of oral cavity and other softening drink and lowered microhardness. Although this concluded was disagreement with Sartori*et al*., [21] who concluded that the denture base resin when immersed in tap water, warm water and denture cleanser (chloride solution) had no effect on the surface hardness of denture base

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CONCLUSION

This study shows that there is a negative effect (decrease in indentation hardness) in all solutions that use during the 1 month duration specially in (EDTA and lacalute) shows more effect on hardness of highly impact acrylic denture base material than (soda+H_2O_2 and Corega).

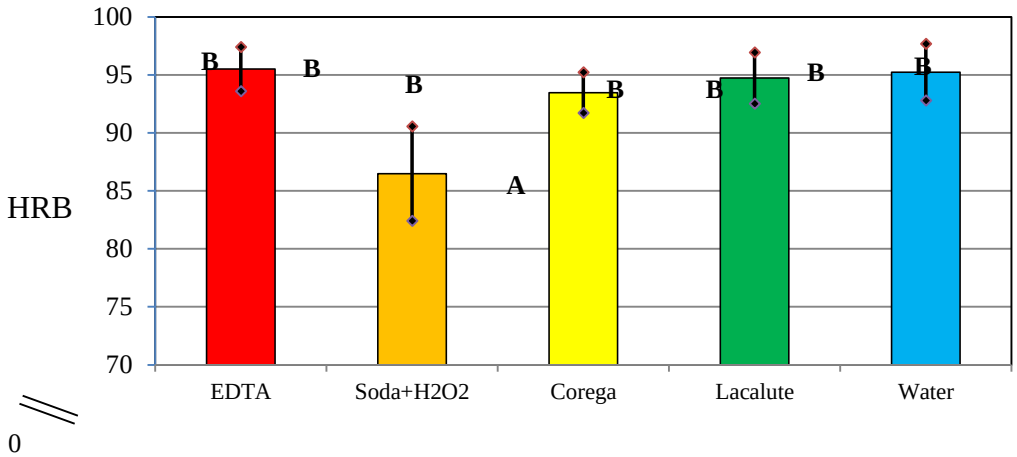
Table (1) Solutions Preparation

Solution no.	Material 1	Weight or volume	Material 2	Weight or volume
1	EDTA	4 g		
2	Soda		H2O2	25%
3	Distilled Water	100 ml		
4	Corega	1 tab = 3.25 g		
5	Lacalut	1 tab= 2.85		

Table (2) ANOVA for Comparison of Indentation Hardness Test in time interval

Time		SS	df	MS	F–value	*p*–value
2 Day	**Between Groups**	307.684	8	38.461	5.554	0.000*
	Within Groups	249.312	36	6.925		
	Total	556.996	44			
7 Day	**Between Groups**	102.668	8	12.834	4.047	0.002*
	Within Groups	114.160	36	3.171		
	Total	216.828	44			
1 Month	**Between Groups**	630.483	7	90.069	9.256	0.000*
	Within Groups	311.372	32	9.730		
	Total	941.855	39			

SOV: Source of variance; SS: Sum of Squares; df: Degree of freedom; MS: Mean Square.
* Significant difference existed at p≤ 0.05.



*Different letters mean significant difference at $p \leq 0.05$.

Figure (1) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test for 2 days

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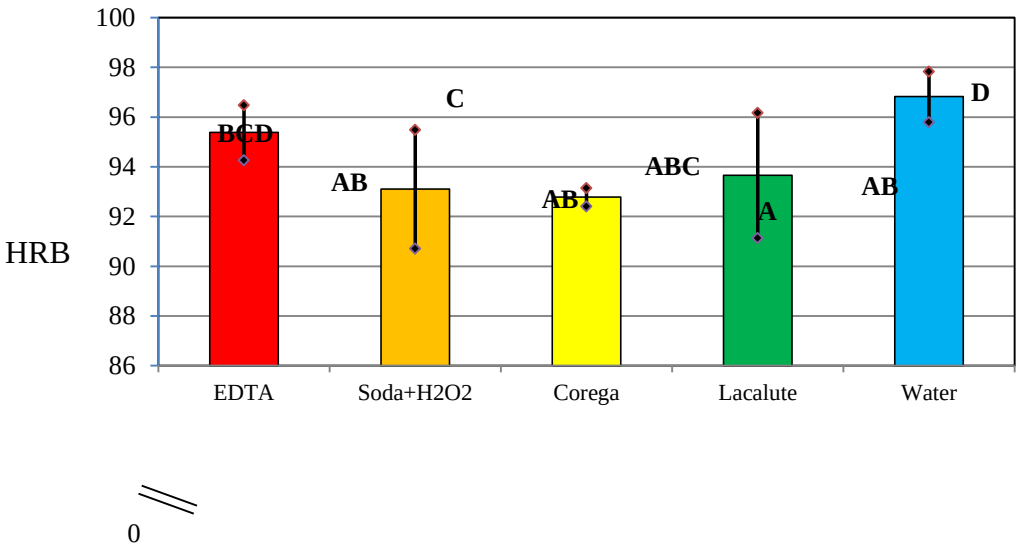

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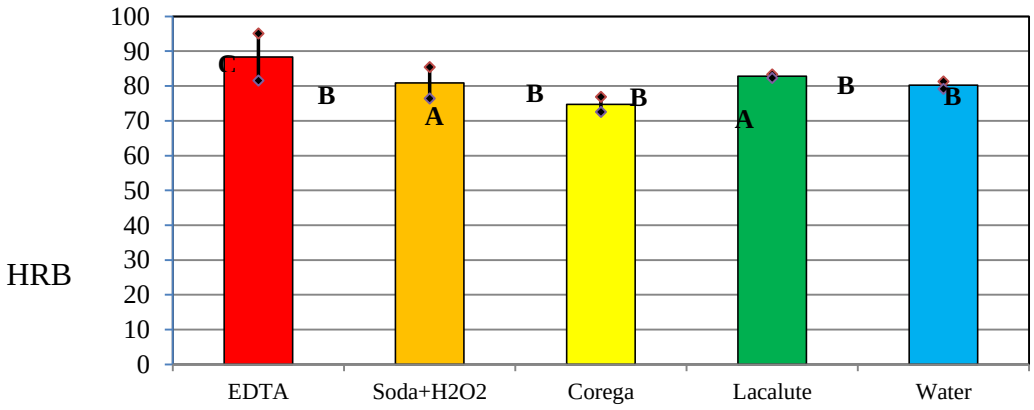
Figure (2) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test for 2 days



*Different letters mean significant difference at $p \leq 0.05$.

Figure (3) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test for 2 days

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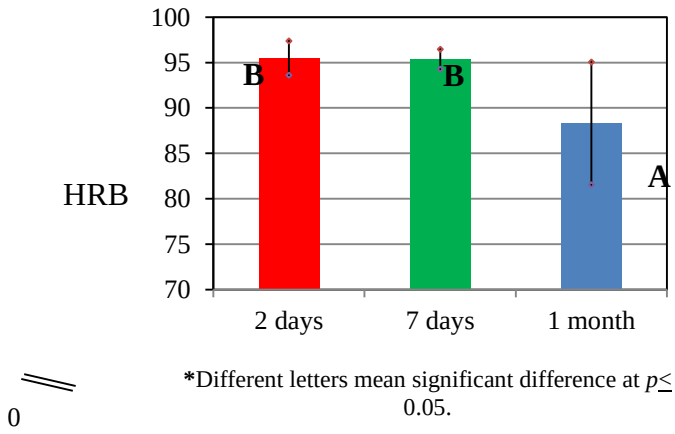
Table (3) ANOVA for Comparison of Indentation Hardness Test among solutions.

Solution		SS	Df	MS	F–value	*p*–value
EDTA	**Between Groups**	169.968	2	84.984	5.045	0.026*
	Within Groups	202.128	12	16.844		
	Total	372.096	14			
Soda + H_2O_2	**Between Groups**	371.817	2	185.909	13.040	0.001*
	Within Groups	171.076	12	14.256		
	Total	542.893	14			
Corega	**Between Groups**	1129.689	2	564.845	218.171	0.000*
	Within Groups	31.068	12	2.589		
	Total	1160.757	14			
Lacalute	**Between Groups**	435.249	2	217.625	57.094	0.000*
	Within Groups	45.740	12	3.812		
	Total	480.989	14			
Distilled Water	**Between Groups**	832.225	2	416.113	153.434	0.000*
	Within Groups	32.544	12	2.712		
	Total	864.769	14			

SOV: Source of variance; SS: Sum of Squares; df: Degree of freedom; MS: Mean Square.

* Significant difference existed at $p \leq 0.05$.



***Different letters mean significant difference at $p \leq 0.05$.

Figure (4) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test in EDTA

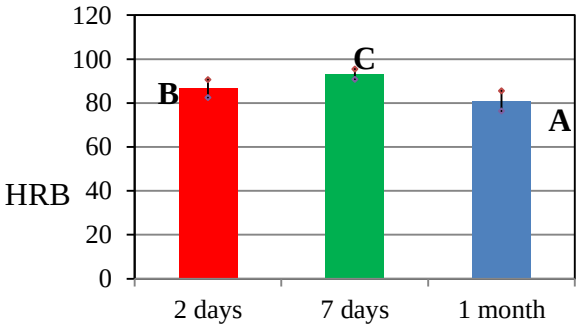


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Figure (5) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test in Soda+H_2O_2

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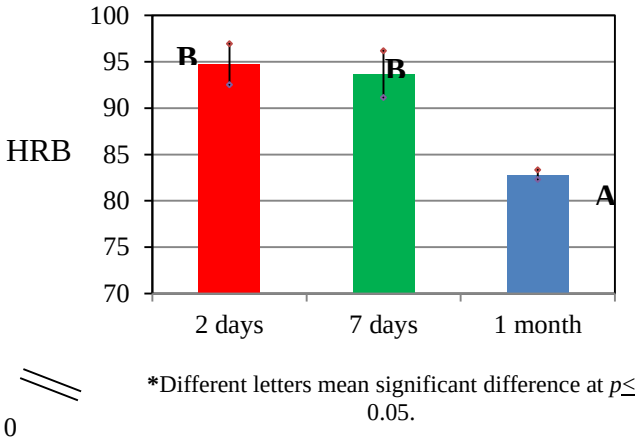
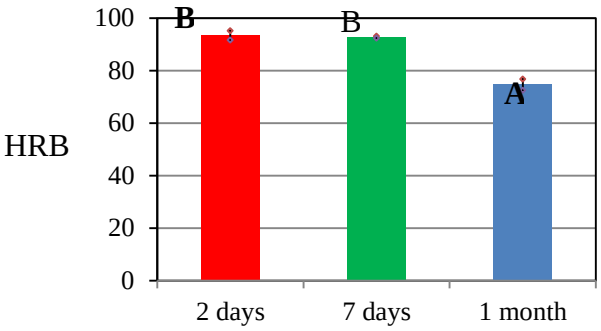


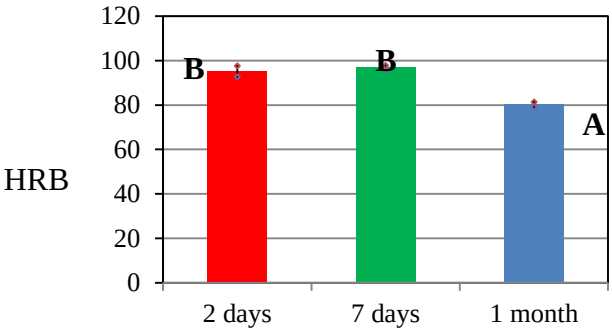
*Different letters mean significant difference at $p \leq 0.05$.

Figure (6) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test in Lacalut



*Different letters mean significant difference at $p \leq 0.05$.

Figure (7) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test in Corega



*Different letters mean significant difference at $p \leq 0.05$.

Figure (8) Mean ± SD and Duncan's multiple rang test of Indentation Hardness Test in distilled water

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