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An in Vitro Study to Evaluate the Effect of Two Disinfectant Solutions on Wettability of Three Elastomeric Impression Materials.

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الخلاصة

الأهداف :تهدف هذه الدراسة إلى تقييم تأثير نوعين من محاليل التطهير (٢٪ جلوتارالديهايد قلوي ، ١٪ هايبوكلورات الصوديوم) في قابلية الترطيب لثلاثة من أنواع مواد الطبعة السيليكونية الشبه سائلة المستعملة في تعويضات التيجان و الجسور في أوقات مختلفة من الغمر .**المواد و طرائق العمل** : ثلاثة أنواع من مواد الطبعة السيليكونية الشبه سائلة شكلت على قالب من راتنج اكريليك مستوي (خمسة من نماذج كل مادة طبعة لكل وقت غمر(٣٠ ، ١٥ و ٦٠ دقيقة) لكل محلول مطهر ، ف إلى المجاميع القياسية). قابلية الترطيب يشار إليها بقياس زاوية الشد السطحي لمحلول فوسفات الكالسيوم على سطح مواد الطبعة المعالجة . **النتائج** : اظهرت النتائج انه لا يوجد أي تأثير هام (significant) لأوقات الغمر على قابلية الترطيب لثلاثة أنواع من مواد الطبعة . مادة الطبعة ذات الصفة (hydrophilic) فقد أظهرت قابلية ترطيب سطحي عالي. الاستنتاجات : المحاليل المطهرة لها تأثيرات مختلفة على كل مادة طبعة مدروسة في هذا البحث . كذلك فإن لهايبوكلورات الصوديوم التأثير الإيجابي الأكبر على هذه الخاصية.

ABSTRACT

Aims: To evaluate the effect of two types of disinfectant solutions(2% alkaline glutaraldehyde, 1% sodium hypochlorite) in wettability of three types of elastomeric impression materials (light body) which are used in crown and bridge restorations at different times of immersion. **Materials and methods**: Three types of elastomeric impression materials (light body) were formed on a flat acrylic resin block and allowed to set(five specimens of each impression material was done for each immersion time(15,30 and 60 minutes)of each disinfectant solution in addition to control groups). The wettability is indicated by measuring the contact angle of aqueous solution of CaSO4 on surface of cured impression materials**. Results**: indicated no significant effect of immersion times on wettability of three types of impression materials. The hydrophilic type produce high wettability. **Conclusions**: The disinfectant solutions have different effects on each impression material. Sodium hypochlorite has the greatest beneficial effect on wettability.

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INTRODUCTION

The extent to which an impression material replicates the structures of the oral cavity depends on, among other variables, its compatibility with gypsum die stone.[1] Besides being dimensionally and chemically stable in the presence of gypsum, an impression material should possess surface properties that allow it to be easily wetted by a standard mix of gypsum. An impression material also must wet tooth structure and soft tissue without developing voids on the surface of the impression itself.[2–6]

Another concern is the risk of transmission of infectious disease from these impressions to the casts and to individuals handling either,[7, 8] as microorganisms can grow on pieces of casts made from contaminated impressions.[9, 10] So this stimulates research to determine whether recommended regimens of disinfection have detrimental effects on the physical properties of impression materials.[11,12]

Disinfectant solutions can alter the surface properties of polymerized impression material, rendering the material more or less wettable by a slurry of gypsum.[13, 14]

The wettability of impression material has been shown to be related to the number or volume of air bubbles generated during the pouring of gypsum casts, which affect the accurate duplication of finish line details and critical areas of prepared abutment teeth during construction of crown and bridge restorations.[2, 15–17]

The wettability of a surface is usually determined by measuring the magnitude of the contact angle formed between a drop

of liquid and the surface in question. So the small values indicate good wettability.[1, 18–20]

Generally, the hydrophilic addition silicones and polyethers were wetted the best, and the condensation silicone and hydrophobic addition silicones the least.[21-25] The wettability was directly correlated to the ease of pouring high–strength stone models of an extremely critical die. [22, 23]

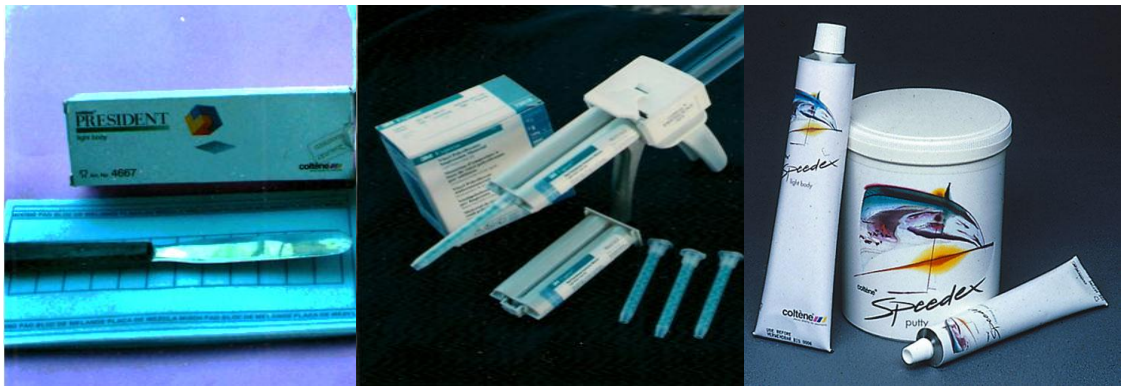
The purpose of the present study was to investigate the effect of AL and SH disinfectant solutions on wettability of three elastomeric impression materials before and after three immersion times (15, 30 and 60 minutes).

MATERIALS AND METHODS

All of the impression materials(light body) and disinfectant solutions used in this study are presented in Table (1) and figure (1).

Table (1): Impression materials and disinfectant solutions

	Material	Batch No.	Manufacturer
Impression Materials	**Express:** Addition Silicone Hydrophilic (Light Body)	7301H	3M, St Paul, Minn.
	Speedex: Condensation Silicone (Light Body)	IC730	Coltene, Alstatten, Switzerland
	President: Addition Silicone Hydrophobic (Light Body)	HJ268	Coltene, Alstatten, Switzerland
Disinfectant Solutions	Sodium Hypochlorite	415992072	CHEM LAB PRODUCTS INC.
	Alkaline Glutaraldehyde	49029	Switzerland



Figure(1): Impression materials:(A) President,(B) Express, (C) Speedex.

All materials were handled according to manufacturers' instructions, at room temperature and relative humidity were 23 ± 2 ºC and 50 ± 10% respectively. For each impression materials thirty five specimens were prepared (including 5 specimens as control group) these specimens were divided to two groups (n=15).In 1st group(A1) the impression materials specimens immersed in 2% alkaline glutaraldehyde ,while the 2nd group (A2) the impression materials specimens immersed in1% sodium hypochlorite. Both 1st and 2nd groups farther subdivided into three

groups(B1,B2,B3)according to three immersion times (15, 30 and 60 minutes).

The catalyst and base components of hand mix impression materials(Speedex and President) were dispensed in equal lengths from their tubes, while the catalyst and base components of automix impression material (Express) were supplied in a self–mixing apparatus with a static mixing nozzle.

Each impression material specimen was formed on a flat acrylic resin block with approximate dimensions (40×40×3 mm) Figure(2).

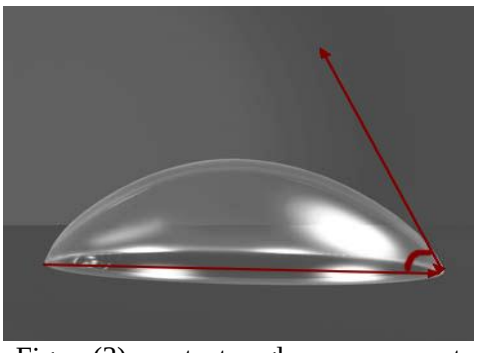
Figure (2): acrylic resin block

The mixed impression material applied on the block, which inverted and placed on clean smooth surface glass sheet to form the flat smooth surface on impression material (surface standardization). Before each use, the glass sheets were cleaned with ethyl alcohol and water, and air dried.

Polymerized specimens of each type of impression material were immersed in the disinfectants for 15, 30 or 60 minutes.

After immersion in disinfectant solution for the specified amount of time, the Specimens were then rinsed in tab water for 30 seconds and air dried, then subjected to testing.

At time of testing each specimen was placed on the table of a telescopic goniometer microscope (Chicago, Ill. USA), one drop of $CaSO_4$ solution (0.2 gm/mL of $CaSO_4$ in distilled water) by medicine dropper was used to dispense liquid drop (approximately 0.05 mL in volume) was placed on the surface of mounted specimen of impression material, the $CaSO_4$ solution simulates the liquid phase of a gypsum slurry . After one minute, contact angles were measured, the angle formed by the flat surface of specimen and the tangent to the drop at the point of three – phase contact was designated the contact angle, Figure (3).



Figure(3): contact angle measurement

An increase in contact angle corresponds to a decrease in wettability , conversely , a decrease in contact angle corresponds to an increase in wettability .

Data were tabulated and statistically analyzed .they were analyzed using analysis of variance (ANOVA) followed by Duncan's New Multiple Range Test at 1%

level of significance to indicate if there were any statistical differences in wettability of impression material groups.

RESULTS AND DISCUSSION

Increased use of disinfection on dental impressions draws attention to the effect of these solutions on wettability of impression material. Careful selection of disinfectant solution will minimize the negative effect on some types of impression material and may even improve the performance of some types of impression material.

Means and standard deviations of contact angles of impression materials before and after the immersion in disinfectant solutions are shown in Table (2).

Table (2): Means and standard deviations of contact angles before (control) and after disinfection

Impression Materials	Control Mean ± SD	Immersion Time (min)	After Disinfection Mean ± SD	
			AL	SH
Express	45.6 ± 3.82	15	55.6 ± 2.46	64.1 ± 0.85
		30	53.3 ±2.33	64.6 ± 1.86
		60	59.3 ± 2.76	71.0 ± 1.27
Speedex	85.7 ± 3.45	15	74.5 ± 0.96	68.7 ± 1.91
		30	69.4 ± 3.60	61.2 ± 0.58
		60	75.4 ± 2.02	53.2 ± 0.63
President	92.4 ± 1.77	15	97.6 ± 1.99	89.4 ± 1.23
		30	99.4 ± 1.22	96.1 ± 0.96
		60	96.4 ± 1.45	95.5 ± 0.61

AL: Alkaline glutaraldehyde; SH: Sodium Hypochlorite; SD: Standard deviation.

Mean square analysis(ANOVA) at level of 1% listed in Table (3) which showed highly significant differences for all variables except immersion times and interaction between the immersion times and disinfectant solutions which indicated no significant differences at level 1% and no significant effect of immersion times on wettability of tested materials , this result comes in agreement with Toh et al [(11)],Lepe et al[(14)],Chong et al [(19)] and Panichutta et al[(24)] which indicated that there is no effect of short immersion times on wettability of addition and condensation silicone impression materials .

Table (3): Mean square analysis for impression materials, immersion times and disinfectant solutions

S.O.V.	d.f.	M.S.
Materials	2	1677.258**
Immersion Times	2	7.5796*
Disinfectant Solutions	2	40.9303**
Interaction Between Materials and Times	4	101.0018**
Interaction Between Materials and Solutions	4	320.15**
Interaction Between Times and Solutions	4	14.9740*
Interaction Among Three Main Factors	8	78.2963**

* Indicated no significant differences at 1% level. ** Indicated highly significant differences at 1% level. d.f.: Degree of freedom; M.S.: Mean square; S.O.V.: Source of variance.

Hassan and Khier[26] tested the contact angle measurements after disinfection elastomeric impression at three time periods (15,30 and 120 minutes) concluded that ,the 30 minutes time period of disinfection yielded the greatest decrease in contact angle data indicate the best wettability.

These result was represented also by the Duncan's New Multiple Range Test which listed in Table (4) to identify statistically the effect of disinfectant solutions and immersion times on wettability of tested impression materials which indicated that the Express impression materials showed high wettability[1, 3, 6, 23] (low contact angle 56.1 degrees) followed by Speedex (condensation silicone) 73.3 degrees, while President (hydrophobic) shows the low wettability (94.6 degrees) [2, 16,27],because a surfactant is incorporated during formulation of Express material, it is likely that the effect of surfactant is attenuated by the disinfectant. Some surfactant apparently remains effective because of the net result is much greater wettability than that of the unmodified addition silicone.[2, 18, 25,28]

Table (4): Duncan's New Multiple Range Test for variables

Disinfectant Solution	Impression Materials	Immersion Times (min)			Impression Materials			Means of Disinfectant Solutions	Means of Immersion Times
		15	30	60	Express	Speedex	President		
Control	Express	45.6^{L}	45.6^{L}	45.6^{L}	45.6^{H}	85.7^{C}	92.4^{B}		
	Speedex	85.7^{E}	85.7^{E}	85.7^{E}					
	President	92.4^{CD}	92.4^{CD}	92.4^{CD}					
AL	Express	55.6^{K}	53.3^{K}	59.3^{J}	56.1^{G}	73.1^{D}	97.8^{A}		
	Speedex	74.5^{F}	69.4^{G}	75.4^{F}					
	President	97.6^{AB}	99.4^{A}	96.4^{AB}					
SH	Express	64.1^{HI}	64.6^{H}	71.0^{G}	66.6^{E}	61.0^{F}	93.7^{B}		
	Speedex	68.7^{G}	61.2^{JI}	53.2^{K}					
	President	89.4^{D}	96.1^{AB}	95.5^{CB}					
Means of Materials					56.1^{C}	73.3^{B}	94.6^{A}		
Disinfectant Solution	Control	74.6^{A}	74.6^{A}	74.6^{A}				74.6^{B}	
	AL	75.9^{A}	74.0^{A}	77.0^{A}				75.7^{A}	
	SH	74.1^{A}	74.0^{A}	73.3^{A}				73.8^{B}	
Times	15 min				55.1^{C}	76.3^{B}	93.1^{A}	74.8^{A}	
	30 min				54.5^{C}	72.1^{B}	95.9^{A}	742^{A}	
	60 min				58.6^{C}	71.4^{B}	94.8^{A}	74.9^{A}	

AL: Alkaline glutaraldehyde; SH: Sodium hypochlorite; Control: Before disinfection. min: Minute , Different letters indicate significant differences.

The effect of disinfectants on Speedex type was indicated by decrease in contact angles with both,[4, 20] while the President type has no significant effect with sodium hypochlorite, and there is a little increase in contact angle with the other (5.4 degrees), the result of this study comes in agreement with that of Cullen et al [16] and Chong et al[19] which concluded that the addition silicone are hydrophilic, a small change in wettability will not likely be clinically significant.

DeWald *et al* [1]has been found that the effect of disinfection was varied among impression materials, and recommended to evaluate each disinfectant and impression material combination individually. Other study Bianca and John[29] concluded that the contact angle increased of two addition silicone after immersion for 30 minutes in acid glutaraldehyde .

Generally, when we study the effect of disinfectant solutions, the results indicated that no significant effect of sodium hypochlorite, while there is a small reduction in wettability after immersion with alkaline glutaraldehyde (about 1.1 degrees).Pratten et al [18]found that short-term immersion disinfection can alter impression material by making them more or less wettable , the surface characteristics and chemical composition may be affected during the disinfecting procedure by diluting or absorbing the surfactant present in the impression material and by increasing the surface roughness.

CONCLUSIONS

According to the limits of this study, the following conclusions can be listed:

1. No significant effect of different immersion times (15, 30 and 60 minutes) on wettability of Express, Speedex and President impression materials.
2. Express impression material represents high wettability.
3. Alkaline glutaraldehyde and sodium hypochlorite disinfectant solutions did not have the same effect on all types of impression materials in this study.
4. Alkaline glutaraldehyde and sodium hypochlorite disinfectant solutions that were tested decrease the wettability of hydrophilic addition silicone.
5. alkaline glutaraldehyde and sodium hypochlorite disinfectant solutions that were tested increase the wettability of Speedex condensation silicone, while there is little effect on wettability of President type.
6. Sodium hypochlorite solutions had the greatest beneficial effect on wettability.

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