

The effect of some chemical disinfection solutions on the color stability of vinyl addition cured silicon

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الخلاصة

الأهداف: تَحَرَّتْ الدراسةُ تأثيرَ طريقةِ تصلبِ مادةِ السيليكون الوجه فكي وتأثير بعض المحاليل الكيميائية المعقمة على مقاييس لون السيليكون الوجه فكي . **المواد وطرائق العمل:** ثلاثون عينةً صنعت من مطاط السيليكون الوجه فكي. العينات (٣*١٠*٢٠) ملليمتر طول ، عرض، وسمك قسّمت إلى مجموعتين (تصلب بارد وحار)، خمسة عشر عينة لكل مجموعة ، خمسة عينات لكل محلول كيميائي معقم مستخدم في هذه الدراسة . وبعد ذلك اختبرت العينات لتسجيل مقاييس اللون. **النتائج:** كان هناك اختلاف معنوي بين المجموعتين الأولى والثانية (تصلب بارد وحار) في قيم L^*a^*b والتغير الأكثر كان في المجموعة الأولى (تصلب بارد) في ماعدا $L1$ و $b3$ التغير الأكثر كان في المجموعة الثانية (التصلب الحار). التغير الأكثر كان في العينات التي انغمرت بمحلول Sodium hypochlorite ، والتغير الأقل كان في العينات التي انغمرت بمحلول chlorhexidine في كلا المجموعتين . **الاستنتاجات:** شفافية العينات الباردة التصلب كانت أكثر من العينات ذات التصلب الحار وذلك نتيجة تأثير الحرارة. العينات التي انغمرت بمحلول Sodium hypochlorite كان التغير اللوني لها أكثر من العينات التي انغمرت بمحلول chlorhexidine وذلك لأنه خامل كيميائياً ويعمل خلال التشبع.

ABSTRACT

Aims: The study investigated the effect of curing methods and the effect of some chemical disinfection solution on the color parameters of the vinyl addition silicon maxillofacial materials. **Materials and methods:** 30 samples were made from maxillofacial silicon rubber. The samples (20*10*3)mm length, width, and thickness, were divide into two group (cold and hot curing)15 sample for each group , 5 sample for each disinfection solution that used in this study and then tested to record the color parameters . **Results:** The result showed there was significant differences between (group 1 and group 2) in all L,a,b values and more changes was found in group 1(cold cure) except in $L1$ and $b3$ the more changes was found in group 2(hot cure). the more color changes was found in the samples that immersed in Sodium hypochlorite. the chlorhexidine showed less value of color changes than the other type. **Conclusion:** Translucency of the cold cured samples was higher than that of the heat cured samples, due to the effect of processing heat . the more color changes was found in the samples that immersed in Sodium hypochlorite. the chlorhexidine showed less value of color changes than the other types because it chemically inert and acting through saturation.

Key words: vinyl addition ,color stability ,chemical disinfection

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INTRODUCTION

Maxillofacial prostheses are used to transform congenital, developmental, and acquired defects of the head and neck into natural appearing reproductions of the missing parts, thus, providing an acceptable appearance and improved function. One of

the Modern materials for external prostheses includes vinyl plastisols, polymethyl methacrylates, polyurethanes, latex, and silicone elastomers ⁽¹⁻²⁾. A maxillofacial prosthesis has been an adequate solution for patients who present malformations in the region of the face and maxilla, mainly due to

trauma, disease or congenital deformities⁽³⁾. The wearing time for facial prostheses averages from 3 months to 1 year. Deterioration is mainly caused by environmental exposure to ultraviolet (UV) light, air pollution, and changes in humidity and temperature⁽⁴⁾. Chemical disinfection can produce some property alterations of the silicones used as a maxillofacial prosthesis material, so it is important to evaluate these alterations during prosthesis fabrication. Sterilization of dental instruments, equipment and materials has long been suggested and accepted as a requirement in the dental care area. Without this procedure, patients, laboratory assistants and dentists are more susceptible to infections. It is therefore absolutely necessary to use a chemical disinfection material when dealing with prostheses. Furthermore, this chemical solution should not be aggressive to human tissues and must preserve the silicone properties⁽⁵⁾. The study investigated the effect of some chemical disinfection solution on the color parameters of the vinyl addition silicon maxillofacial materials. The study also aims to find the curing method after immersion in some chemical disinfection with minimum color changes.

MATERIALS AND METHODS

Thirty samples were made from maxillofacial vinyl addition silicon rubber material (polymerkit, wales). The samples (20*10*3)mm length, width, and

thickness⁽⁶⁾, were divide into two groups according to the method of curing : group1 cold cure and group2 heat cure polymerization (15 samples as cold cure and 15 samples as heat cure).each group divided in to three sub group ,in the first sub group immersed(5)sample in chlorhexidine solution (0.2%)(Tosel,Turky)for 30 hour. In the second sub group immersed (5)samples in iodine solution(0.1%)(Konix Germany) for 30 hour and in the third sub group immersed(5)samples in sodium hypochlorite solution (1%)(Saudi Arabia) for 30 hour. The examined period simulated approximately one year, because 30 hours is 360 days of service for a 5 minute daily treatment⁽⁷⁾. Samples were prepared by mixing the material manually according to the manufacturer's instruction 10:1 part A to part B, an intrinsic liquid pigment (pink) colored added 0.2% by weight⁽⁸⁾, all samples were prepared by pouring the material in stone molds, clamped in their flasks and pressed by hydraulic pressing machine up to 150 psi to avoid air entrapment. The cold cured samples left for self-polymerization for 24 hours according the manufacturer's instruction. The heat cured samples polymerized for 1 hour at 100°C according the manufacturer's instruction. After the polymerization of the cold and heat cured samples they were tested by the colorimeter (Easy shade, vita company, Germany) to record the color parameters. Color

observations were performed using one illumination light, and the same white background below the samples. The CIELAB system uses the three dimensionless colorimetric parameters L , a , b whereby L indicates the brightness, a describes the red-green content and b the yellow-blue content. The samples were able

to serve as controls, since they were not damaged or otherwise affected by the measurements and could be measured before

and after the disinfection procedures^{9,10,11}.

The color values L^*a^* and b^* that were collected from the colorimeter to facilitate the statistical analysis, the statistical examination were carried out by using SPSS program using ANOVA and Duncan's multiple range tests at ($P < 0.05$).

RESULTS

Group statistics were listed in table (1)

Results of one way ANOVA test were shown in table 2. Table 1: group statistics

Table (1) : group statistic (Independent Samples Test)

		Mean	Std. Deviation	t	Sig. (2-tailed)
L1	Cold cure (group1)	47.1600	.37815	4.254*	.003
	Hot cure (group2)	51.5000	2.24944		
L2	Cold cure(group1)	47.8400	.15166	.933	.378
	Hot cure(group2)	47.6600	.40373		
L3	Cold cure(group1)	48.0600	.05477	7.244*	.000
	Hot cure(group2)	46.7400	.40373		
a1	Cold cure(group1)	42.4400	.39115	6.138*	.000
	Hot cure(group2)	35.2600	2.58612		
a2	Cold cure(group1)	43.1200	.08367	19.304*	.000
	Hot cure(group2)	40.0800	.34205		
a3	Cold cure(group1)	43.4200	.16432	11.184*	.000
	Hot cure(group2)	41.2000	.41231		
b1	Cold cure(group1)	29.4400	.11402	4.792*	.001
	Hot cure(group2)	27.7800	.76616		
b2	Cold cure(group1)	29.2200	.08367	2.357*	.046
	Hot cure(group2)	29.1200	.04472		
b3	Cold cure(group1)	29.0800	.04472	3.773*	.005
	Hot cure(group1)	29.3000	.12247		

L1 value for samples which immersed in chlorhexidine solution

L2 value for samples which immersed in iodine solution

L3 value for samples which immersed in sodium hypochlorite solution

a1 value for samples which immersed in chlorhexidine solution

a2 value for samples which immersed in iodine solution

a3 value for samples which immersed in sodium hypochlorite solution

b1 value for samples which immersed in chlorhexidine solution

b2 value for samples which immersed in iodine solution

b3 value for samples which immersed in sodium hypochlorite solution

The result in table (1) showed there was significant differences between (group 1 and group 2) in all L,a,b values and more changes was found in group 1(cold except in L1 and b3 the more changes was found in

group 2(hot cure). The result in table (2) showed there was significant differences between all L, a, b values in group 1(cold cure)

Table (2): One way ANOVA test of group 1 (cold cure)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.201	2	1.101		
Within Groups	.676	12	.056	19.538	.000
Total	2.877	14			
Between Groups	2.521	2	1.261		
Within Groups	.748	12	.062	20.225	.000
Total	3.269	14			
Between Groups	.329	2	.165		
Within Groups	.088	12	.007	22.455	.000
Total	.417	14			

The result in table (3) showed that there was significant differences between all L, a, b values in group 1(cold cure). The significant differences between samples which immersed in Chlorhexidine and iodine and between Chlorhexidine and Sodium hypochlorite but the more changes

in the samples which immersed in Sodium hypochlorite in L and a values. In b values the significant differences between samples which immersed in Chlorhexidine ,iodine and Sodium hypochlorite but the more changes in the samples which immersed in Chlorhexidine

Table (3): Duncan's multiple range test of group 1 (cold cure)

		Chlorhexidine	Iodine	Sodium hypochlorite
L	Mean	47.1600	47.8400	48.0600
	Sequence	a	b	b
A	Mean	42.4400	43.1200	43.4200
	Sequence	a	b	b
B	Mean	29.4400	29.2200	29.0800
	Sequence	a	b	c

*The similar letter mean that there was no significant differences .

The result in table (4) showed there was significant differences between all L, a, b values in group 2(hot cure)

Table (4) :Result of one way ANOVA test of group 2(hot cure)

		Sum Squares	of df	Mean Square	F	Sig.
L	Between Groups	63.749	2	31.875	17.754	.000
	Within Groups	21.544	12	1.795		
	Total	85.293	14			
a	Between Groups	99.617	2	49.809	21.423	.000
	Within Groups	27.900	12	2.325		
	Total	127.517	14			
b	Between Groups	6.897	2	3.449	17.129	.000
	Within Groups	2.416	12	.201		
	Total	9.313	14			

The result in table (5) showed that there was significant differences between all L, a, b values in group 2(hot cure).

Table (5): Duncan's multiple range test of group 2 (hot cure)

		Chlorhexidine	Iodine	Sodium hypochlorite
L	Mean	51.5000	47.6600	46.7400
	Sequence	a	b	b
a	Mean	35.2600	40.0800	41.2000
	Sequence	b	a	a
b	Mean	27.7800	29.1200	29.3000
	Sequence	b	a	a

*The similar letter mean that there was no significant differences .

The significant differences between samples which immersed in Chlorhexidine and iodine and between Chlorhexidine and Sodium hypochlorite but the more changes in the samples which immersed in Chlorhexidine in L values and in a and b values the more changes was found in

samples which immersed in Sodium hypochlorite.

DISCUSSION

Color stability is an important property in the maxillofacial materials.The study was aiming to find the effect of some chemical disinfection solution on the color

parameters. The result in this study showed that there was significant differences between group 1(cold cure) and group 2 (hot cure) .the result also showed there was significant differences between all L, a, b values in group 1(cold cure) and between all L, a, b values in group 2(hot cure) in the three chemical solutions that used in this study (Chlorhexidine, iodine , and Sodium hypochlorite). In regard to the curing method, results shown that the cold cure method had higher L, a and b value than the heat cure method, what means it is more translucent, this can be explained by the effect of processing temperature⁽¹²⁾ that affects the physical properties of the material. Sodium hypochlorite was the most chemical disinfection solution that cause color changes in this study in group (1) and group (2) more than iodine and chlorhexidine . The observed changes in color and hardness could be associated with the surface characteristics of the polymers along with the extraction of some compounds from the polymer matrix to disinfection solutions or the water^{13,14}. Mancuso, et al.¹⁵ (2009) reported that extrinsic factors, such as the absorption and adsorption of substances, causes discoloration. Significant color changes were also reported after using Sodium hypochlorite in maxillofacial silicone elastomers, with and without pigmentation^{16,17}, as it was also presented in

our results. chlorhexidine showed low value in L and a values in group (1) and in a and b values in group (2). chlorhexidine solution is biocompatible and the immersion disinfection technique is considered the most favorable in treating facial silicone prostheses¹⁸. 1% chlorhexidine chemically inert and acting through saturation¹⁹.

CONCLUSIONS

Within the limitations of the study and based on the obtained results, the following conclusions in relation to vinyl addition cured silicon were all the chemical disinfection solution used in this study showed significant differences between them but the chlorhexidine showed less value of color changes than the other types.

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