The Effect of Thickness on The Color Parameters of The Vinyl Addition Maxillofacial Elastomer

Abdullah J. Mohammed Radhwan H. Hasan
College of Dentistry, Mosul University

Received 16 November 2013 **Accepted 30 March 2014**

Abstract

Aim of the study : The study investigated the effect of material thickness on color parameters of maxillofacial silicon . Materials and methods :sixty samples made of silicone rubber. Samples (20 * 10 * 3) mm length , width , thickness, and (20 * 10 * 1.5) mm length, width, and thickness were divided into three groups, white, yellow and pink (10 samples a thickness of 3 mm and 10 samples thickness of 1.5 mm in each group) . And then the samples were tested for recording color parameters .Results : There was a significant difference for the three color values at different thicknesses, where the value of * L and a * in the three groups decreased as thickness increased while the b * value rose up with the thickness . Conclusions: The increase in the thickness of the maxillofacial silicon associated with a decrease in the value of L * , a * and a rise in the value of b *.

Key words: maxillofacial elastomers, thickness, curing methods, color stability.

الخلاصة

أهداف الدراسةِ: تَحرّتْ الدراسةُ تأثيرَ سمك مادة مطاط السليكون الوجه الفكي والمستعملة في تعويض اجزاء الوجه والفكين المفقودة على مقاييسِ لونَ المادة لما له من تاثيرعلى جمالية الجزء المصنع واندماجه مع بقية اجزاءالوجه. المواد وطرائق العمل: ستون عينة صنعت مِنْ مطاطِ السيليكونِ الوجه فكي. ٣٠ عينة تحمل الابعاد (٢٠*١٠*٣) مليمتر طول ، عرض، وسُمك،و ٣٠ عينة اخرى بالابعاد(٢٠*١٠*١.٥) مليمتر طول ، عرض، وسُمك قسمتَ إلى ثلاث مجموعاتِ أبيضَ ، أصفرَ ووردي (١٠عينات بسمك ٣ملم و١٠ عينات بسمك ١.٥ملم في كُلّ مجموعة من الالوان الثلاثة). وبعد ذلك إختبرَت العينات لتَسجيل مقاييس اللونَ. النَتائِج: كان هناك اختلاف معنوي لقيم اللون الثلاثة عند اختلاف السمك حيث ارتفعت قيمة *Lو*a في المجموعاتِ الثلاث بانخفاض السمك بينما ارتفعت قيمة *bبارتفاع السمك. الاستنتاجات: الزيادة في سمك مادة مطاط السيليكون الوجه الفكي تترافق مع نقصان في قيمة *L و *a وارتفاع في قيمة *b.

Introduction

Tumors, trauma, or genetic factors are the main causes of maxillofacial defects, such defects requires surgical and prosthodontic treatment, however the plastic surgeries may not be the treatment of choice in large defects[1,11,2,12,17].The aim of the maxillofacial prostheses is to improve appearance and function by reproducing the congenital, developmental, and acquired defects of head and neck. One of the Modern materials for external prostheses includes vinyl plastisols, polymethylmethacrylates, polyurethanes, latex, and silicone elastomers[1,15].maxillofacial prosthesis should be comfortable and caring about aesthetic this can improve the patient's health and may improve quality of life[15].The biggest challenge for professionals during

maxillofacial prostheses fabrication is the color matching to human skin. Collecting precise information about the color of the skin is an important step[13,16]. Many methods have been used in attempts to achieve an accurateskinappearance match. In comparison with a chairside visual trial-and-error method[13,8] and facial skin shade guides[9], instrumental colorimetric techniques havebeen noted to provide more consistent, reliable, and quantitative assessmentof an object's color under controlled conditions[4,10].Contact measuringinstruments, including most colorimeters andspectrophotometers,have been commonly used in maxillofacial prosthetic measurement[13,6,7].

Aims of the study

This study investigated the effect of maxillofacial material thickness on its color parameters .

Materials and methods

Sixty samples were fabricated using vinyl addition maxillofacial silicon material (polymerkit, Wales) these samples were divided according to their thickness to 30 samples (20*10*1.5)mm length, width, and thickness respectively, and 30 samples (20*10*3)mmlength, width, and thickness respectively, Samples were prepared by mixing the material manually according the to the manufacturer's instruction 10:1 part A to part B, an intrinsic liquid pigment (white, yellow, and pink) colored added 0.2% by weight[5].

According to the intrinsic color used the samples were divided into three groups A,B, and C, for each thickness.After mixing of the silicon, material were poured in a stone molds, clamped in their flasks and pressed by hydraulic pressing machine up to 150 psi to avoid air entrapment. The heat cured samples polymerized for 1 hour at 100°C according the manufacturer's instruction.

After the polymerization heat cured samples 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 color values h, b, and c that were collected from the colorimeter and transformed into their corresponding L*a*and b* by Photoshop computer program to facilitate the statistical analysis, the statistical examination were carried out by using SPSS program using paired samples T-test at ($P<0.05$).

Results

Descriptive statistics of the three groupsfor each thickness (number, mean, standard deviation, and standard error) were listed in table 1. Results of paired T test showed that there is significant difference between the color values of the two material thicknesses proposed in this study.Where in groups A, B, and C (white, yellow, and pink)there was significant decrease in L*and a*values and increase in b*value with the increase in the thickness of the material as shown in table 2, 3, and 4.

Table 1 descriptive statistics of the three groups

Color	Color value	Thickness mm	N	Mean	Std. Deviation	Std. Error Mean
White	L	1.5	10	81.8000	.83666	.37417
		3	10	74.4000	3.84708	1.72047
	a	1.5	10	3.4000	.54772	.24495
		3	10	-2.8000	.44721	.20000
	b	1.5	10	-2.4000	.54772	.24495
		3	10	5.8000	.83666	.37417
Yellow	L	1.5	10	75.2000	1.30384	.58310
		3	10	66.0000	4.41588	1.97484
	a	1.5	10	-55.4000	2.19089	.97980
		3	10	-52.6000	2.50998	1.12250
	b	1.5	10	66.8000	1.64317	.74833
		3	10	69.4000	1.67332	.73485
Pink	L	1.5	10	72.8000	1.30384	.58310
		3	10	62.4000	2.50998	1.12250
	a	1.5	10	4.4000	.89443	.40000
		3	10	1.8000	.44721	.20000
	b	1.5	10	2.4000	.54772	.24495
		3	10	7.0000	.70711	.31623

Table 2 shows the results of paired T test in group A

		Paired Differences					Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	L1.5mm - L3mm	-7.4000	3.57771	1.60000	-11.8423	-2.9577	.010
Pair 2	a1.5mm - a3mm	6.2000	.83666	.37417	5.1611	7.2389	.000
Pair 3	b1.5mm - b3mm	-8.2000	1.09545	.48990	-9.5602	-6.8398	.000

Table 3 shows the results of paired T test in group B

		Paired Differences					Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	L1.5mm - L3mm	-9.2000	4.86826	2.17715	-15.2447	-3.1553	.013
Pair 2	a1.5mm - a3mm	-2.8000	3.70135	1.65529	-7.3958	1.7958	.166
Pair 3	b1.5mm - b3mm	2.6000	.89443	.40000	1.4894	3.7106	.003

Table 4 shows the results of paired T test in group C

		Paired Differences					Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Pair 1	L1.5mm - L3mm	-10.4000	3.36155	1.50333	-14.5739	-6.2261	.002
Pair 2	a1.5mm - a3mm	2.6000	.89443	.40000	1.4894	3.7106	.003
Pair 3	b1.5mm - b3mm	-4.6000	1.14018	.50990	-6.0157	-3.1843	.001

Discussion

The color stability of the maxillofacial elastomers is an important factor that affects the prognosis of the maxillofacial appliances. This study investigated the effect of different thicknesses on the color changes in the material, where maxillofacial appliances do not have one uniform thickness, where the thickness of the appliance differs from one part to another depending on the area to be restored. Results have shown that the means of L*value (brightness) of the material of the three groups underwent significant changes that was inversely proportional with the increased thickness. Shokry et al[9] who investigated the effect of different porcelain thicknesses on the color properties found that the brightness of the material decreased, a* and b*values increased as the thickness increased,thisphenomenon can be explained by the increase of absorptionof incident light with thicker specimens that reflectreduced quantity of light and, thus, lower L* values, it is clear that the maxillofacial elastomers could follow the same physical behavior, where most of the transparent material decrease their transparency as their thickness increase. All the specimen underwent significant decrease in a*value with the increasing thickness of the material, however, these changes in group A was at the positive horizontal axis for the (1.5mm) thickness, and it was located at the negative part of the horizontal axis for the (3mm) thickness, in the second group (yellow) a*values of both thicknesses were located at the negative side, while a*values of both thicknesses in group B (pink) were located at the positive side. The mean of b*value in the three groups increased significantly and proportionally with the thickness, in group A for (1.5mm) thickness located at the negative side of the axis, and it was located at the positive side of the axis for the (3mm) thickness, while b*values in group B, and C were located at the positive side of the axis.horizontal axis values (a*) and (b*). Each has an “axis” that can range from (–a) to (+a) and (–b) to (+b). More specifically, (–a) represents green and (+a) represents red, whilst (b+) is represented by yellow and (b-) is represented by blue [3].All the white specimen in the study exhibited tendency toward the red color with the least thickness (positive a*value), and they showed a tendency to the green color when the thickness of the specimens increased (negative a*value), b*value of the white specimen turned from the negative value (blue color tendency) when the thickness was (1.5mm) to the positive value (yellow color tendency) when the thickness

increased to (3mm). The second group specimens showed a negative a*value for both thicknesses, what means that the yellow colored specimens a tendency toward the green color, while the b*value of the yellow increased with thickness but all in the positive region (yellow color region), which is the intrinsic pigment used in the fabrication of the specimens in this group. The specimens of group C exhibited a decrease in a*value and increase in b*value as the thickness of the specimens increased, both a* and b*values of group C were in the positive region, that means a tendency toward the red color, which coincides with the pink intrinsic pigment used in the fabrication of group C specimens, and b*value suggests a tendency of this group specimen toward the yellow color as the thickness of the specimens increased. As far as this study's findings there is independent, dissimilar behavior of each intrinsic pigment used in the study.

Conclusion

Under the limitation of the current study, we can conclude the following:

1. Brightness (or lightness L*value) of the maxillofacial appliance is inversely proportional with the thickness of the appliance.
2. Means of a*value of the three groups specimen decreased as the thickness of the appliance increased.
3. Means of b*value were directly proportional with the increasing thickness of the maxillofacial appliance.
4. White colored specimens showed tendency to transform from +a* (red) to -a* (green) and transform from –b*(blue) to +b*(yellow) as the thickness of the specimens increased.
5. Yellow colored specimens showed tendency toward the green color with both thicknesses.

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