Effect of Oil Paint Addition on Porosity of Scleral Part of Acrylic Ocular Prosthesis

Wael Abdul Alrazzaq

(Lecturer) -Middle Technical University/ College of Health & Medical Technology - Baghdad , Iraq

ABSTRACT

Background: white acrylic resins are widely used for fabrication of scleral part of ocular prostheses to restore acquired or congenital ocular defects. However, such materials are not available in the local markets. Several additive materials, hence, must be applied to the prosthesis to match the colour of natural eye. The aim of this study was to assess the effect of adding titanium dioxide oil paints to scleral part of ocular prosthesis on its porosity.

Methods: there were 20 samples in total. The first group was fabricated without addition of oil paint and considered as control. The second group was constructed from heat cured acrylic resin with addition of oil paint in a concentration of 1 ml. A surface area of 1cm^2 was limited in the center of each specimen &observed under optical microscopy and numbers of pores per area was manually determined. All values were analyzed using SPSS version 20 and comparison between 2 groups was obtained using independent t test.

Results: there was an increase in the mean values of porosity following addition of oil paint. The control group presented a lower mean value of porosity compared to experimental group. however, no significant differences between control and TiO_2 group where *P* >0.05.

Conclusion: the incorporation of titanium dioxide into clear acrylic resin increases its ' porosity .

الخلاصة

الاكريلك هو المادة المستخدمة بشكل واسع في مجالات طب الاسنان وتعويضات الوجه (على سبيل المثال العين الاصطناعية).يتطلب تصنيع العين الاصطناعية استخدام الالوان الزيتية لغرض الحصول على لون مطابق للعين الطبيعية وهذا قد يكون له بعض التأثير على الخواص الفيزيائية لمادة الاكريلك. ان الغرض من الدراسة الحالية هو دراسة تأثير إضافة التيتانيوم وايت على مسامية الاكريلك. شملت الدراسة على مجموعتين رئيسية. تتألف كل مجموعة من 10 عينات. تم تعريض جميع العينات لاختبار المسامية .

النتائج: أظهرت النتائج أن هناك زيادة في مسامية الاكريلك

الخلاصة: الاستنتاج من هذه الدراسة أن استخدام الاصباغ الزيتية زاد من مسامية مادة الاكريلك.

INTRODUCTION

The main causes of ocular abnormality are trauma (i.e. motor accidents), eye disease (i.e. basal cell carcinoma) and congenital malformation (i.e. anophthalmia) [1,2]. Such deformities have a harmful effect on the patient. The fabrication of ocular prostheses, hence, maintains the eye socket and restores the natural appearance for the patient [3-5]. The substances, which utilized for ocular prosthesis should have suitable properties (i.e. biocompatibility, excellent aesthetic, durability and non-irritant to eye socket [6]. White coloured acrylic materials are commonly utilized for construction of scleral part of the ocular prosthesis. Such materials, however, are not available in local markets. In order to match the natural eye, the use of pigments such as oil paints is necessary to match the colour of natural eye [7-8]. In the literature, it was found that the use of oil paint improved the micro-hardness of acrylic resin but had a negative effect of flexural strength [9,10]. The porosity is a complex phenomenon and it found on acrylic denture base depending on many factors polymerization method, the material and flasking technique used. The porosity can be defined as the presence of voids or pores on the surface (i.e. acrylic). It is difficult to determine the reason of porosity whether from polymerisation or the material utilized [11]. The present study was hence to assess the oil paint addition on porosity of scleral part of ocular prosthesis. The null hypothesis imposed that adding of oil paint has no effect on porosity of scleral part of ocular prosthesis.

MATERIALS AND METHODS

Materials and sample preparation

In current study, the materials utilized were clear heat polymerizing acrylic (Spofadental,Czech Republic), and titanium dioxide (TiO2)pigment (Grumbacher, USA) as well as dental stone (Zhermack, Italy). There were 2 main groups; control and TiO_2 groups. The control group was made from clear acrylic resin without addition of oil paints. The experimental group was fabricated from acrylic resin with the addition of oil paint with a concentration of 1 ml (22g acrylic powder + 9ml liquid monomer + 1ml TiO_2).

Preparation of the acrylic specimens

The wax patterns with dimensions of 30mm diameter and 2 mm thickness were constructed into desired shape to fabricate acrylic specimens for porosity test [12]. Acrylic specimens were constructed using conventional flasking techniques [13] .The wax patterns were placed into lower half of a metal flask, which coated with a Vaseline to easily remove the stone mould following deflasking. The dental stone was mixed with water according to manufacturer instructions (100g/25m1) and placed into lower half, the wax patterns were positioned and half of them were exposed(Figure 1).

Figure 1. Wax pattern for porosity test

Once the stone has set, the upper half was coated with a Vaseline and positioned over the lower half and filled with dental stone. After one hour, the flask was put into boil out machine to remove all the wax for 5 minutes. The flask was opened and waxy residue was completely removed with a detergent (Figure 2).

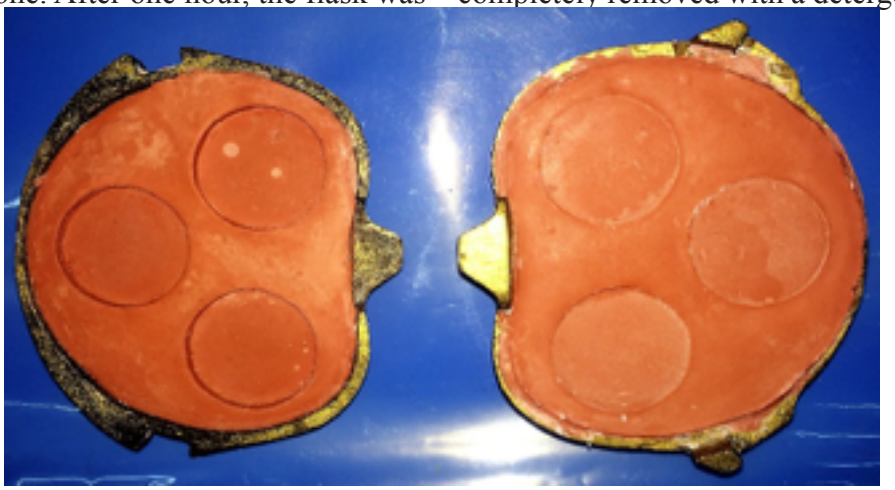

Figure 2 . mould preparation

The control group was fabricated by mixing 10 ml of monomer with acrylic powder (22 g). When the acrylic reached a dough, it was packed into mould, cured in water path according to the manufacturer instructions. Once cooling, the samples were removed from the flask, finished and polished.

Experimental group

The oil paint (TiO2) in concentration of 1 ml was added using a syringe to 9 ml of monomer and then mixed with acrylic powder (22 g) (Figure 3).

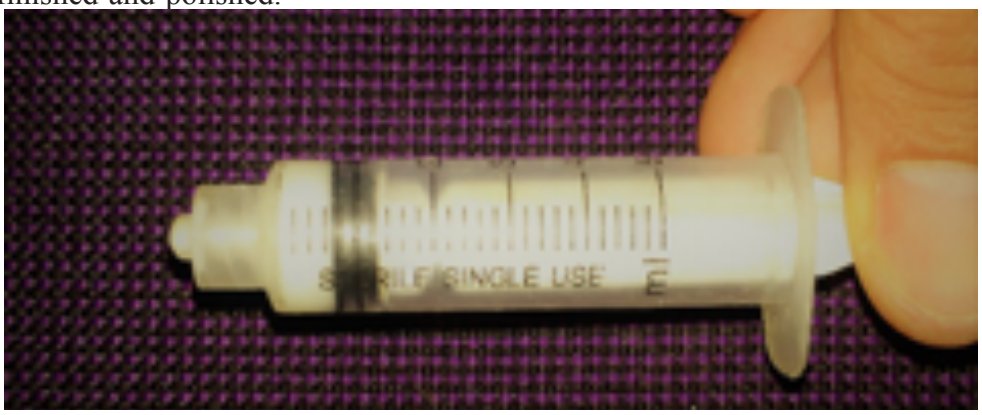

Figure 3. Percentage of titanium dioxide filler

Porosity test

The specimens were immersed in a solution of permanent black ink for 30 Minutes, washed for 10 seconds and then dried with absorbent paper. In the center of each specimen, a surface area of 1cm2 was limited and observed under light microscope (OLYMPUS, Japan)(Figures 4 and 5). Next , the numbers of pores per area was manually counted for

each group [13,14].

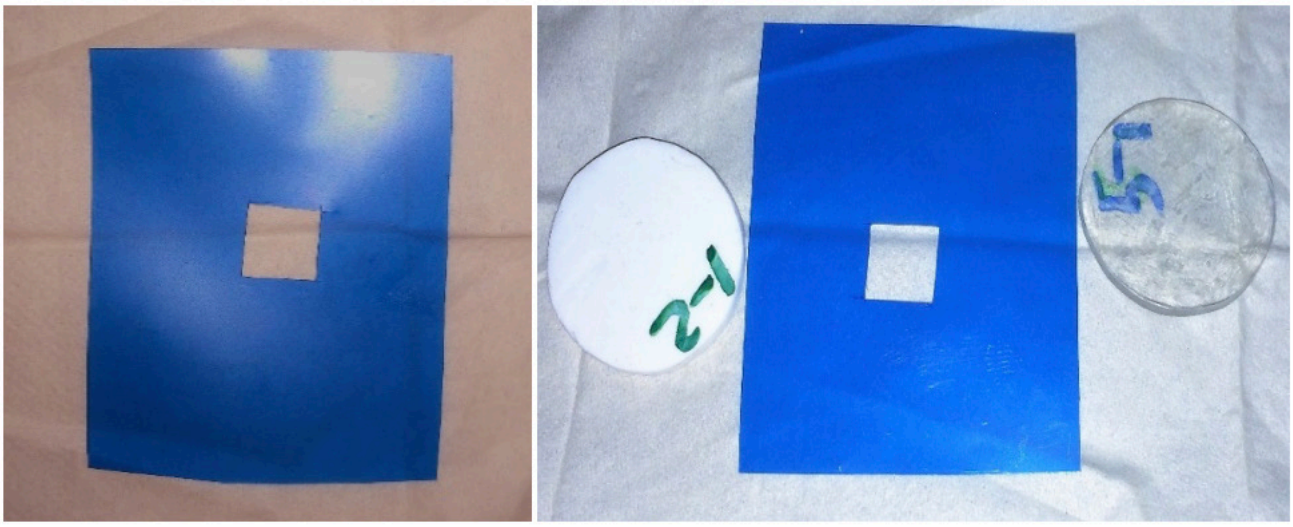

Figure 4 . A surface area of 1 cm² was limited in the center of each Specimen.

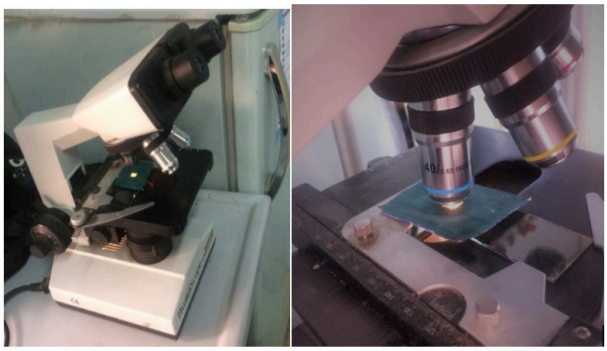

Figure 5.Testing the specimens with optical microscopic

Statistical Analysis

The SPSS v 20 was used to analyze samples data and provide a summary of mean and standard deviation. The independent t test was used for comparison between 2 groups.

RESULTS

All values of porosity groups are listed in table 1. All values of mean and standard deviation are shown in the table2.

Table (1): porosity values for all groups' samples.

Samples no	*Control group*	*Experimental (TiO_2)*
1	24	50
2	22	39
3	28	37
4	26	38
5	33	34
6	31	27
7	27	47
8	44	30
9	25	26
10	19	43

Table 2. mean and standard deviation of all groups for porosity test

Groups	*Mean*	*Standard deviation*
control	27.90	6.96
Experimental (TIO2)	37.10	8.08

.It can be seen that there was an increase in the mean values of porosity following addition of oil paints. In addition, the independent T test demonstrated that there were no significant differences between two groups.

Table 3: Independent Samples Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
porosity	Equal variances assumed	.464	.504	-2.725-	18	.014	-9.20000-	3.37606	-16.29284-	-2.10716-
	Equal variances not assumed			-2.725-	17.613	.014	-9.20000-	3.37606	-16.30402-	-2.09598-

DISCUSSION

White acrylic resins are the materials of choice for fabrication of scleral part of ocular prosthesis. Though, such materials are not available in the local markets. Several additive materials, therefore, should be added to match the colour of natural eye. The aim of this study was to assess the effect of adding titanium dioxide oil paint to scleral part of ocular prosthesis on its porosity. There were 2 groups; control and TiO2 group. In the current study, the study exhibited that there was a considerable increase in the porosity of acrylic resin after addition of filler as density values are lower than the density values of the control. The presence of fillers incorporated within the material lead to decrease the density and make pits and voids within the acrylic surface. There is an adverse relationship between density and porosity which was approved by Keller and Lautenschlager[15] that correlated between density and porosity and found that when density increased, porosity was decreased. The present results disagrees with a study which carried out by Lawra[16] who found the incorporation of both TiO2 and FeO2 decreased the acrylic resin' porosity. From the present study, it is concluded that the incorporation of titanium dioxide into clear acrylic resin increases its ' porosity. However, no significant differences between two groups. The addition of titanium dioxide filler in concentration of 1ml is gradually suitable to be used for matching the scleral part of ocular prosthesis. Further investigation will be required to assess the effect of oil paints on other physical properties of acrylic resin.

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