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The Effect of Using Modified Flask on the Porosity of Processed Heat- Cure Acrylic Resin

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Abstract

Porosity is an important property of acrylic resin material because it affect other properties like strength, esthetic and cause bacterial or fungal growth lead to unhealthy dentures. This paper Study the possibility of reducing the porosity of heat- cure acrylic resin by making a modification in the flask of processing .The processing flask was modified by constructing a tongue like projection fixed to the upper half of the flask in order to spread the high temperature occurred in the center of the muffle. In the this research; forty lower denture base with bite rim samples were prepared from heat-cure acrylic resin denture base. The study include 4 testing groups depending on the type of curing cycle and using of ordinary traditional and modified flask in curing process, each group contain 10 samples. One way ANOVA with Tukey's test between tested groups in regarding the type of flasking and curing cycle are indicated, the results revealed a significant difference at (P=0.05) when compare between group 2(I.I.O.F)and 3(S.C.M.F) and between group2and 4(S.C.O.F), and also between group 3and 4. While there was a non significant differences between group 1,2 and1,3 and finally between group1and4. Less Porosity was observed in the group of samples that cured with slow curing cycle in modified flask when compare with other groups.

Key words: Modified Flask, Porosity, Heat- cure acrylic resin.

1. Introduction

Acrylic denture base resins have been used for the past eighty years in dental practice and are still indispensable in their area of indication [1] they used for bases of removable partial and complete dentures, tooth supported or implant retained over dentures, orthodontic appliances, stents surgical guides for implant placement and for temporary crowns [2,3].

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Poly (methyl methacrylate) resin has been widely used as a denture base material due to its desirable properties of excellent aesthetic, low water sorption and solubility, relative lack of toxicity, ability to repair and simple processing technique [4,5,6]. In spite of the development of various denture base materials, acrylic resin remains the principle choice. Many processing methods had been developed for the purpose of minimizing polymerization shrinkage, but some warpage after processing in investable [7]. To overcome these undesirable processing effects, various flasking polymerization techniques and materials had been studied [8,9].

Craig and Powers [10], demonstrated that for heat polymerized plastics the curing temperature must be maintained close to 74°C, because the polymerization reaction is strongly exothermic, the heat of reaction will be added to the heat used to raise the material to the polymerization temperature, which lead to form of pores (porosity).

The presence of surface and subsurface voids may compromise the physical, aesthetic and hygienic properties of a processed denture base [11].

In the present study modified flask was used in polymerizing process of heat-cure acrylic resin in compression molding technique and compare porosity of simulated bite rim with that cured by using ordinary flask.

2. Materials and methods:

At first, forty identical mandibular stone casts (Elite Double; Zhermck, Rovigo, Italy). Were made by using a typical silicone mold. Then forty mandibular simulated bite rim were fabricated by using a silicone mold to provide the same shape and dimensions(fig1).

Figure (1) :- Mandibular simulated bite rim

To provide enough rigidity for the duplicating material, it supported by custom flask made from metal container. Each mold will have three sprue holes , and molten base plate wax was poured in to the molds throw this holes. Then allowed to cool at room temperature (21°C± 2°C) for 2 hours before removal.

All experimental groups were compression molded with heat-cure acrylic resin (PAN acrylic, heat-cure acrylic type1-class1-ISO 1567 Istanbul), which mixed according to the manufacture instruction and used when it reach to the dough stage cured in a curing machine (Thermotron Dental Products, Piracicaba, Sp, Brazil).

The tested samples were divided in to two groups, the control group flasked with ordinary flask while the experimental group was flasked with a new modified flask ,the modified flask was locally designed and manufactured by the author in which a tongue- like shape projection was constructed from commercial pure cupper into three sizes (small, median and large) in order to accommodated the arch size(fig 2). the tongue- like shape projection was fixed to the upper half of the flask by two stainless steel screws (fig 3). In this study the median size tongue- like shape projection was used because it's the most possible size (fig 4).

Figure (2) :- Three sizes of tongue- like shape projection

Figure (3):- Modified flask with tongue- like shape projection

Figure (4):- Modified flask with median size tongue- like shape projection.

Each group (control and experimental) was subdivided in to two groups depending on the type of curing cycle. The first subgroup was cured with immediate immersion of the flasks in the boiling water for (30min.) while the second group was immersed in the curing machine at room temperature ,reach the boiling temperature with 1hour and leave in boiling for 30min(fig 5) .

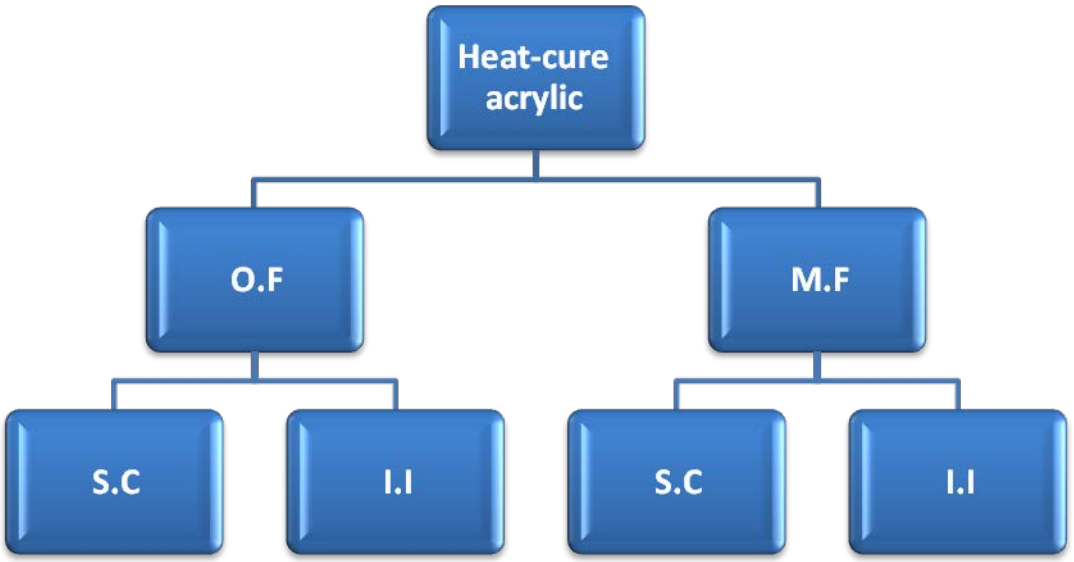


Figure (5):- A diagram illustrates the design of the study.

O.F= Ordinary flask.

M.F=Modified flask.

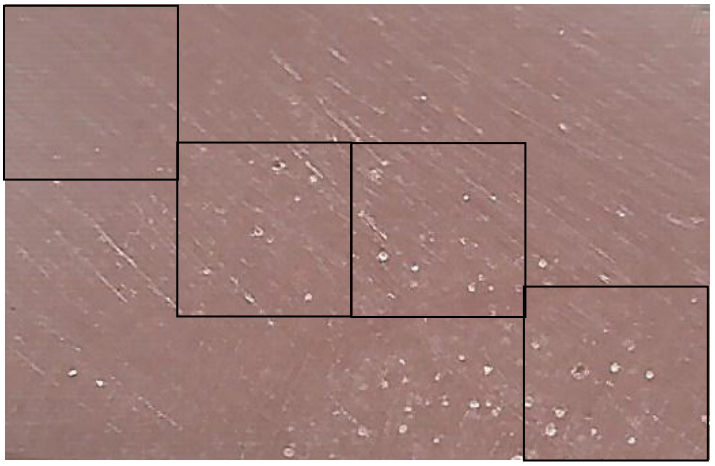
S.C=Slow curing.

I.I=Immediate immersion.

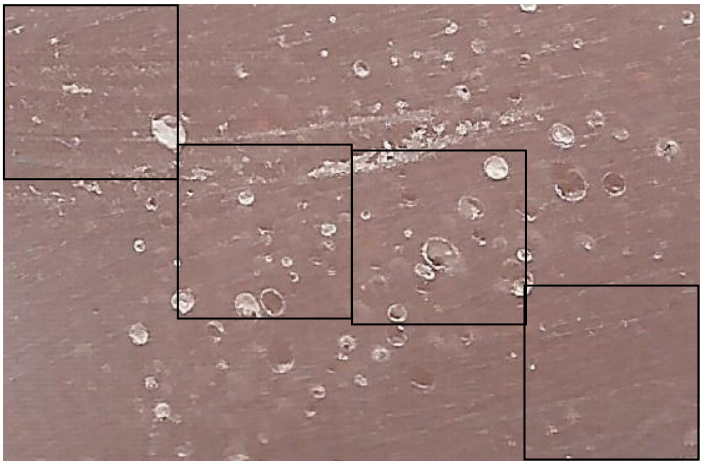
After completing curing, cooling at room temperature was required, then the flask was opened and the processed samples were removed from the investing material.

Adherent plaster was cleaned and flashes of acrylic were removed with an acrylic bur to get smooth surface.

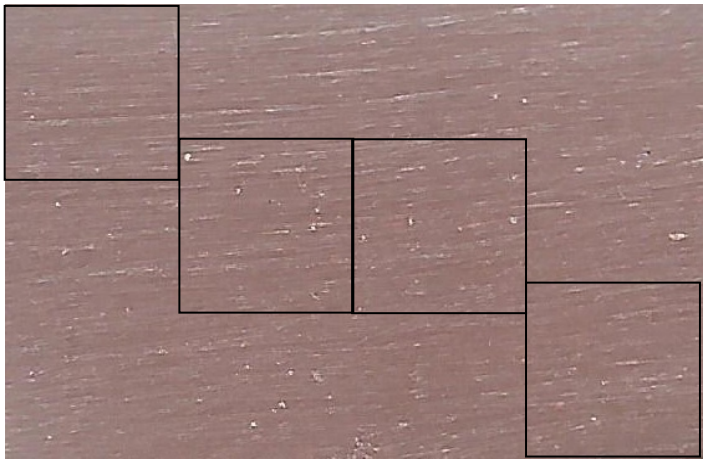
In order to prepare the samples for testing the porosity of them, every sample was divided in to three sections by making a cutting of each side of it and at the same distance (20mm.)from the posterior border, with continuous water cooling, then take the two posterior sections of each sample and make it smooth by using silicon carbide grit paper 240 followed by grade 400 and 600 . The sections were Scand by using 2D scanner (HP Deskjet2510,China).The resolution of scanning was 600mpi (fig 6), the images were magnified in to (7 times) by using the computerized focus to make a rectangular field from each section, and 4 equal square fields of (2.3 cm.) in each rectangular were made, two of them at the periphery of the rectangular and the other two at the center, then record the number of pores in each field. The mean of pores for each rectangular was calculated by dividing the total number of pores in all of the four fields by the number of those fields [11,12].



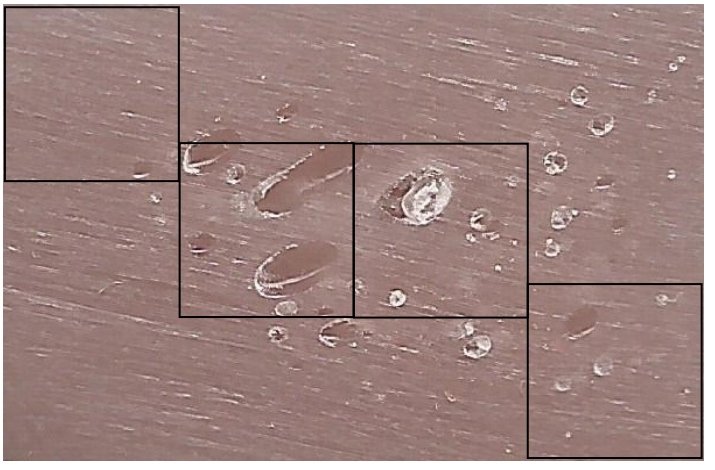
Immediate immersion with plate



Immediate immersion without plate



Slow curing with plate



Slow curing without plate

Figure (6) :- Porosity of each testing group.

Descriptive statistics which include table of mean, SD, and SE were used along with inferential statistics which include, one way analysis of variances(ANOVA) and Tukey's test at 95%level of confidence (P=0.05).

3. Results

Descriptive and inferential statistics for porosity of heat- cure acrylic resin experimental groups as influenced by the type of flask that used in curing process and the type of curing cycle were evaluated, then compare between the result of them to evaluate the modified flask and determined its effect in reducing the porosity that occurred in heat-cure acrylic resin during its curing process.

The results showed that the lowest porosity mean value was obtained in samples which cured with slow curing cycle with modified flask(S.C.M.F) while the highest mean value of porosity was obtained in samples which cured with immediate immersion and in ordinary flask(I.I.O.F)

One way ANOVA with Tukey's test between tested groups in regarding the type of flasking and curing cycle are indicated the results indicate a significant difference at (P=0.05) when compare between(I.I.O.F) group and (S.C.M.F) and between group(I.I.O.F) and (S.C.O.F), and also between group (S.C.M.F) and (S.C.O.F). While there was a non significant differences between group (I.I.M.F), (I.I.O.F) and(I.I.M.F), (S.C.M.F) and finally between (I.I.M.F)and(S.C.O.F).

Table 1: Mean value of porosity for each rectangular

NO.	groups			
	I.I.M.F	**I.I.O.F**	**S.C.M.F**	**S.C.O.F**
1-	0	2	0	2
2-	7.5	4	0	0.5
3-	1.5	4	0	2.5
4-	0.5	0.5	0.5	2.5
5-	0.5	2	0	1
6-	1	5	0.5	0.5
7-	0.5	2	2	0
8-	6	3.5	0	3.5
9-	1.5	2.5	1	1.5
10-	4	3.5	2	2

Table 2: descriptive and inferential statistics

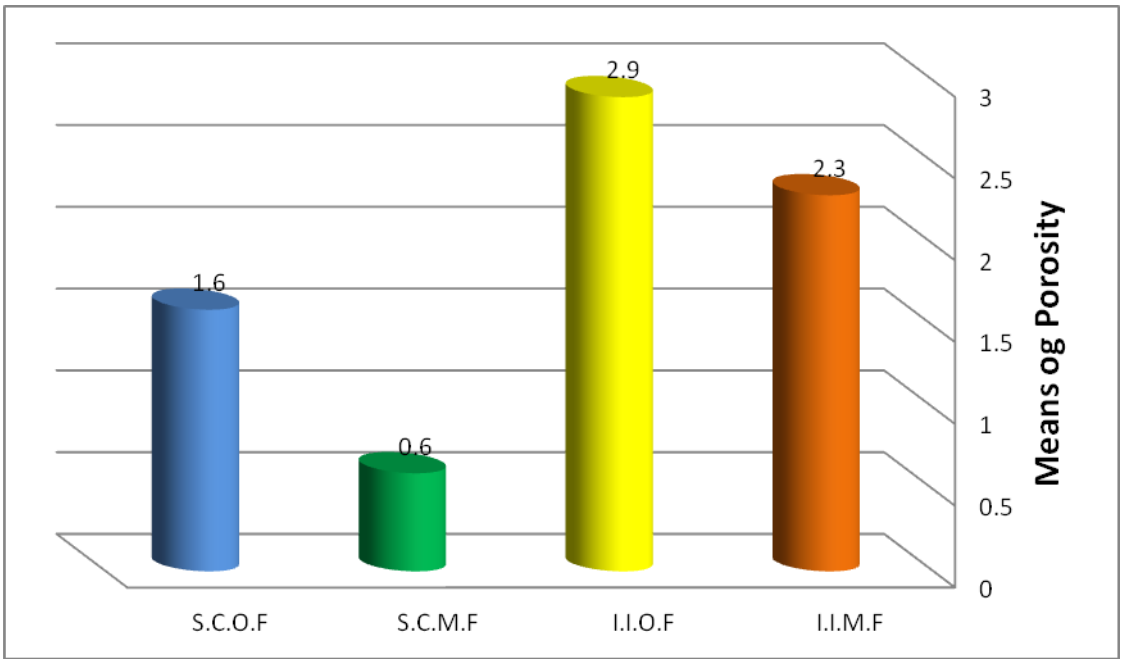
Groups	mean	SD	SE
I.I.M.F	2.30	2.62	0.83
I.I. O.F	2.90	1.33	0.42
S.C.M.F	0.600	0.810	0.26
S.C. O.F	1.60	1.10	0.35

Table 3: LSD

Groups	P- value			
	I.I.M.F	**I.I. O.F**	**S.C.M.F**	**S.C. O.F**
I.I.M.F		0.529	0.078	0.451
I.I. O.F			0.000 ★	0.029★
S.C.M.F				0.034★
S.C. O.F				

(★= Significant P<0.05)

Fig(7):- Bar chart of Porosity mean values



4. Discussion

From the results, it can be concluded that there was a significant differences between samples which cured with immediate immersion of the flask in the curing machine with ordinary flask when compare with samples which cured with slow curing cycle with ordinary flask. Since that the group of immediate immersion of the flasks in the curing machine had the highest mean value of porosity, this result seemed to be due to the fact that heat- cure acrylic resin which cured with slow curing cycle is less porosity than that which cured with rapid curing cycle. This result was agree with (Almusawi) who reported that porosity resulted in processed specimens when an initial processing temperature greater than 74°C was used in curing dental resins, this resulted in temperature within the specimens greater than 100°C, which is the boiling point of the monomer. This evidence is also approved by (Alneami) as she said that No porosity was found in the conventional resin in thicknesses up to 19.5 mm. while the boilable resin developed porosity in thicknesses of 6 mm and greater. And (Firtell and Harman) who mention that the high value of porosity in specimens polymerized in water at 90°C and 100°C may due to the heat of reaction accompanying polymerization which may raise the temperature of the resin dough to the boiling point of monomer (100.3°C).

Also there was a significant differences in dentures groups which cured with slow curing cycle when compare between them (with and without plate). The group of dentures that flasked with plate had less porosity mean value and this was may be due to the using of the metal plate which appear to be absorbed some of the heat which generated from the polymerization process, so this will reduce the temperature of acrylic resin and reduce the monomer to reach to its boiling temperature leading to reducing the porosity of the processed acrylic resin.

5. Conclusion:

it can be concluded from the results of the present study, that using of metal plate will reduce the porosity of heat-cure acrylic resin which cured with conventional molding technique and this will improve the mechanical properties strength of it.

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