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AN OPTIMALLY SOLVING DENTISTRY INTERNAL PURITY IN HEAT POLYMERIZED ACRYLIC RESIN WITH DIFFERENT POLYMERIZATION METHODS

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ABSTRACT

A Polymerization Method for dentistry is a collaboration poured into the knowledge base by combining different chemical reactions and polymerization methods. In this study, The results of this study indicated that there was a difference in the amount of internal porosity in the hot polymerized acrylic resin with different methods in sample group A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 '), namely 11.520 in the sample group. B (temperature 25 ° C for 0 '→ 70 ° C for 90' → 100 ° C for 30 ') which is 7,860 and the sample group C (temperature 25 ° C for 0' → 74 ° C for 60 '→ 100 ° C for 30 ') 14,150. slightly compared to sample A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 ') and sample C (temperature 25 ° C for 0' → 74 ° C for 60 '→ 100 ° C for 30 '). The temperature of the polymerization process does not exceed the boiling point of the monomer, the amount of porosity contained in the acrylic resin will be low, the monomer boiling point is 100.8 ° C.

Keywords: Optimally Solving Dentistry, Different Polymerization Method, and Polymerization Acrylic Resin.

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INTRODUCTION

Acrylic resin has been used in dentistry as a base for dentures. Acrylic resin is a thermoplastic material that is formed by combining methacrylate molecules. In general, acrylic resins can be divided into three types, namely self-polymerized acrylic resins, light-polymerized acrylic resins, and hot-polymerized acrylic resins. Hot polymerized acrylic resin is still in great demand as a base material for dentures because it has a fairly good aesthetic quality, low water absorption and is easy to process so that many processing methods have been developed for the purpose of minimizing the occurrence of shrinkage. Acrylic resin often experiences porosity and strength. and the hardness becomes fewer causing cracks or fractures of the denture base after several uses. Porosity occurs because the mixing process between powder and liquid is not good so that air is trapped and evaporation of monomers during the polymerization process. Acrylic resin polymerization methods have also developed due to developments in science, technology and dental materials. The polymerization methods commonly used are heating using infrared, water bath and microwave methods. Research conducted by (Luay N Abood , 2007) which used different polymerization methods and different thicknesses of acrylic resin, namely using conventional and microwave methods, the results of this study said that there were differences in the porosity of acrylic resin, conventional methods had less porosity. Previous research was also carried out by (Moosa R, 2012) who conducted research on the effect of the acrylic resin polymerization method on porosity at different temperatures and times. His research used different temperatures, 70 ° for 45 minutes, 70 ° for 7 hours, 70 ° for 9 hours, and 60 minutes. The results of this study indicate that there is a difference in the amount of porosity using a low temperature and a long time the porosity value in acrylic resin is less, namely at 70º for 9 hours the porosity value is 02.0%. (Mohammed T. Al-Khafagy et al, 2013) examined using conventional polymerization methods with different times, with the results that there were significant differences between samples using a polymerization time of 100ºC for 30 minutes compared to those using a polymerization time of 74ºC for 2 hours. The polymerization method with a long polymerization time had less porosity than a fast polymerization time. (Sunint Singh, et al, 2013) examined the evaluation of the surface porosity of hot polymerized acrylic resin using a water bath and microwave. The result of this research is using water bath there is a little porosity. Microwave-based acrylic resin has a significant increase in porosity compared to water bath. Research conducted by (Sahela Nisar et al, 2015) examined the effect of polymerization variations and different powder and liquid ratios on the strength and porosity of acrylic resin, in this study using different specimens, namely 25ºC for 0 minutes then increased 70ºC for 90 minutes then raised again. 100ºC for 60 minutes, 25ºC for 0 minutes then set the temperature to 70ºC for 60 minutes, then raise the temperature again to 100ºC for 30 minutes, 70ºC for 0 minutes then raise the temperature again to 100ºC for 30 minutes, 100ºC for 0 minutes then raise the temperature again to 100ºC for 30 minutes. The results of this study showed a large porosity of the specimens which were directly placed at boiling water temperature of 100ºC. This research was conducted to see the amount of internal porosity in hot polymerized acrylic resin when it was carried out using different polymerization methods.

In this study, there are 3 types of acrylic resins used in dentistry, namely heat-cured acrylic resins, self-cured self-polymerizing acrylic resins, and light-cured resins. Acrylic resins that are widely used in the manufacture of dentures are

RESEARCH AND METHODOLOGY

heat cured acrylic resins.

1. At this stage the polymer and monomer gradually mix to form a precipitate. The monomers will gradually seep into the polymer to form a fluid that is not united. During this stage, there is little or no interaction at the molecular level. The
2. polymer granules remain unchanged and the consistency of the mixture is still coarse and granular.
3. In the second stage the monomer will begin to seep or enter the polymer surface. The polymer chain will be dispersed in the monomer fluid. This polymer chain will release the bonds thus increasing the thickness of the mixture. At this stage the mixture will be fibrous in the form of threads and will be sticky when touched or pulled.
4. In the third stage the mixture will be smoother and more homogeneous. The mixture will no longer stick to the touch with your hands or a spatula. At this stage, the mixture is ready to be formed and put into the mould.
5. In the fourth stage there is no more monomer left, because the monomer has fully absorbed the polymer and part of the monomer evaporates. The mass at this stage is already plastic and can no longer be formed and inserted into the mould.
6. In the fifth stage, it appears that the dough will become hard and stiff, this is due to the evaporation of free monomers. Clinically the mixture looks very dry.

a) fulfilment: After the dough reaches the dough stage, the dough is put into the mould on the cuvette. After filling the dough, the first press is carried out with a pressure of 1000 psi to reach the mould is filled densely and the excess resin is removed then the final press is carried out with a pressure of 2200 psi then the cuvette is locked. Then the cuvette was left at room temperature for 30-60 minutes.

b) Polymerization: The cuvette was then heated using a water bath at 70 0^{C} for 90 minutes and continued with 100 0^{C} for 30 minutes.

c) refrigeration: After heating, the cuvette was left in the water bath for 30 minutes for cooling. After that the cuvette was placed under running water for 15 minutes and allowed to cool to room temperature.

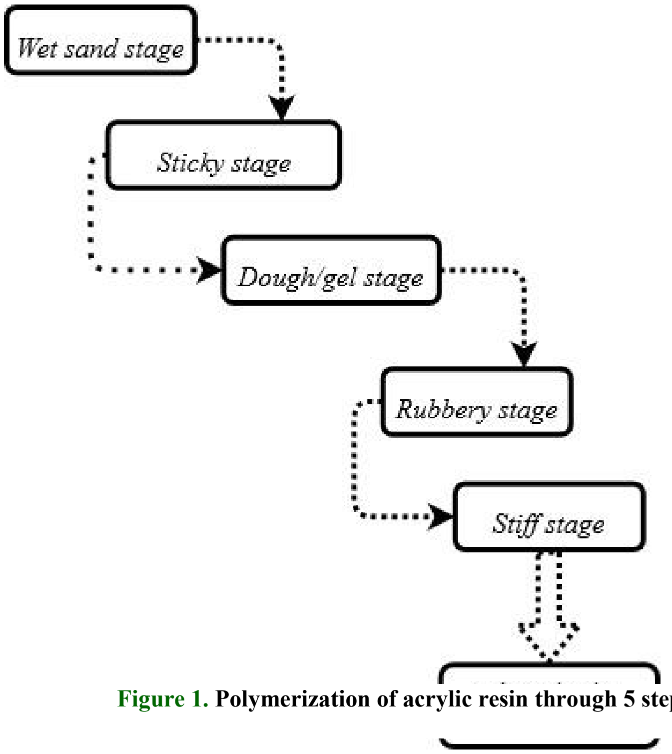

Figure 1. Polymerization of acrylic resin through 5 steps during mixing

MATERIAL AND METHOD

3.1. Polymerization Method

There are several polymerization methods of acrylic resin for prosthetic bases of various sizes, shapes and thicknesses. One of the polymerization methods according to Inservice is to use a water bath with a constant temperature of 74 ^{0}C for 8 hours or more, without heating the temperature after that slowly cooled down to room temperature then allowed to cool for 30 minutes then immersed in running water for 15 minutes. Another polymerization method is at a temperature of 74 ^{0}C for 2 hours then increasing the temperature to 100 ^{0}C for 1 hour, then slowly cooling it to room temperature then allowed to cool for 30 minutes then immersed in running water for 15 minutes. The boiling point of the monomer is 100.8 ° C, if the temperature of the polymerization process exceeds the boiling point of the monomer, it will cause a lot of porous in acrylic resin, on the other hand, if the temperature of the polymerization process does not reach the boiling point, it causes unreacted monomers. The polymerization method, according to Craig, uses a water bath with a temperature of 74 ^{0}C, where the monomer boiling point reaches 100.3 ^{0}C, if the polymerization process exceeds the monomer boiling point, it causes a lot of porous.

3.2. An Optimally

The samples of this study were blocks of hot polymerized acrylic resin with a size of 20 mm x 20 mm x 2 mm:

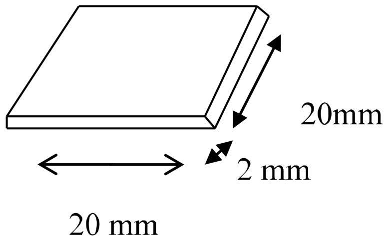

Fig 2. Sample shape and size

In this study, the minimum destination sample size was based on Federer's formula:

$$(t-1)(r-1) \geq 15$$

definition:
t= Number of treatments
r=Number of repetitions

In this research, 3 treatment groups will be used, namely the polymerization group with different temperatures, namely 25 ºC for 0 minutes increased by 74 ºC for 90 minutes increased by 100 ºC for 60 minutes, 25 ºC for 0 minutes increased by 70 ºC for 90 minutes increased by 100 ºC for 30 minutes, 25 ºC for 0 minutes increased by 70 ºC for 60 minutes increased by 100 ºC for 30 minutes, so that t = 3.Based on the above formula, the number of samples (n) for each group can be determined as follows :

$(t-1)(r-1) \geq 15$
$(3-1)(r-1) \geq 15$
$2(r-1) \geq 17$
$2r-2 \geq 17$
$r \geq 8.5$

From the above calculations, the minimum number of samples for each group is 8.5, in this study a sample size of 10 was taken for each treatment group. The total sample in this study was 30 experiments.

3.3. Variable Input

a) Controlled Variable

Type of hot polymerized acrylic resin, Sample size 20 mm x 20 mm x 2 mm. Heat polymerized acrylic resin ratio (2 g polymer: 1 ml monomer). Cast time setting is 15 minutes. Cast to water ratio according to factory dosage 300 gr: 90 ml. The pressing pressure of the hydraulic cuvette is 1000 psi - 2200 psi. 500 rpm polishing speed. Polishing time 3-5 minutes. Sand paper grid. Opening of the cuvette at 25 ° C.

b) Uncontrolled Variable

Acrylic resin stirring speed. Cast stirring speed. Stirring time of acrylic until it reaches the dough phase. Time of stirring the cast until it is homogeneous.

3.4. Operational definition

Hot polymerized acrylic resin is a denture base material which is formed by mixing a powder containing a polymer and a liquid containing a monomer which polymerizes by heating. Porosity is boasting within the surface at the base of the denture.

RESULT AND DISCUSSION

In this result obtained were there were differences in the amount of internal porosity with different polymerization methods. The mean and standard deviation of the amount of porosity in sample group A was 31.759 ± 60.317, in sample group B was 7.860 ± 3.141, and in sample group C was 14.150 ± 17.988.

Table 1. The average number of internal porosities of the hot polymerized acrylic resin with different polymerization methods in sample group A, sample group B and sample group C

No	Amount **porosity**		
	experiment A	**experiment B**	**experiment C**
1	15,2	5,5	6,4
2	11,1	5,0	5,2
3	7,5	5,6	7,2
4	15,2	8,7	8,1
5	14,7	15,4	64,6
6	16,5	7,3	14,6
7	8,5	7,2	5,0
8	8,0	7,7	11,3
9	10,5	10,5	11,5
10	8,0	5,7	7,6
X ± SD	**11,520 ± 3,547**	**7,860 ± 3,141**	**14,150 ± 17,988**

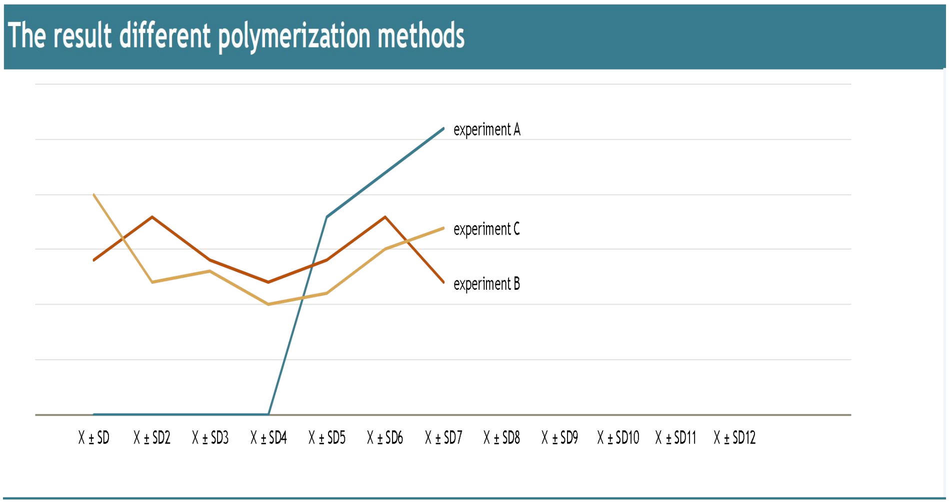

Figure 3. Result The average number of internal porosities of the hot polymerized acrylic resin with different polymerization methods in sample group A, sample group B and sample group C

The results of this study also showed that the group in sample C had a higher amount of porosity in the hot polymerized acrylic resin, namely the group in sample C, namely 14,150. Then after the sample group C, namely group A 11,520. And the last sample group B is 7,860.

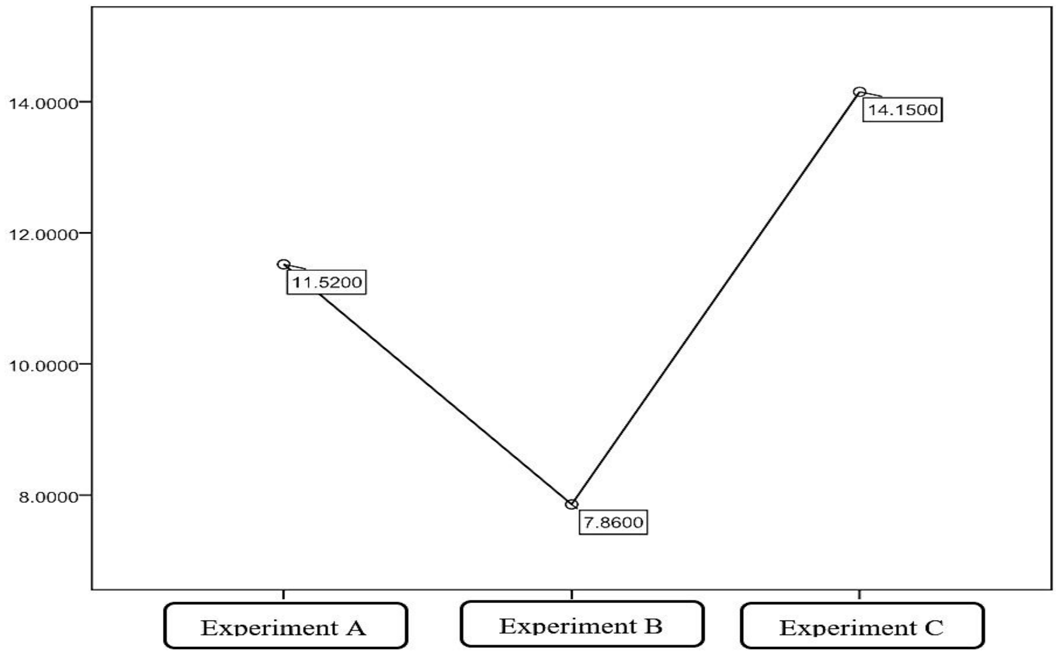

Figure 4. The average value of the porosity amount of the hot polymerized acrylic resin

Based on the average graph above, it is known that the highest average number of porosities is in sample group A 31,759, while the lowest number of porosities is in sample group B 7,860. Then there is sample group B, the difference in the amount of porosity in the acrylic resin is much different from the sample group C due to the possibility that it is due to the fast polymerization time in sample group C.8. different time which revealed that the fast polymerization time the porosity value of the acrylic resin will be more.

To find out whether the data is normally distributed or not, the normality test is performed first. The data normality test used in this study was the Shapiro-Wilk test, then continued by using the Kruskal-Wallis test to see the difference in the amount of porosity of hot polymerized acrylic resin in each group.

Table 2. Normality test using the Shapiro-Wilk test

Classification	Statistics	Df	Sig.
Experiment A	.858	10	.073
Experiment B	.818	10	.024
Experiment C	.520	10	.000

The results of the Kruskal-Wallis test in Table 3 showed that the value of p = 0.205 (p <0.05), it was concluded that there was no statistically significant difference regarding the amount of internal porosity of hot polymerized acrylic resin with different polymerization methods, namely group A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 '), sample group B (temperature 25 ° C for 0' → 70 ° C for 90 '→ 100 ° C for 30') and sample group C (temperature 25 ° C for 0 '→ 74 ° C for 60' → 100 ° C for 30 '). This also shows that Ho (initial hypothesis) is rejected. In this study, the results of the Mann Whitney test in Table 4, the amount of internal porosity of the hot polymerization acrylic resin with different polymerization methods showed that there were insignificant / significant differences in sample group A with sample group B, sample group A with sample group C and sample group B with sample group C with a significance value of p = <0.05.

CONCLUSION AND FUTURE WORK

In this study, The results of this study indicated that there was a difference in the amount of internal porosity in the hot polymerized acrylic resin with different methods in sample group A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 '), namely 11.520 in the sample group. B (temperature 25 ° C for 0 '→ 70 ° C for 90' → 100 ° C for 30 ') which is 7,860 and the sample group C (temperature 25 ° C for 0' → 74 ° C for 60 '→ 100 ° C for 30 ') 14,150. Based on the research of Al-Khafagy et al (2013) who examined conventional polymerization methods with different times, it was said that there was a small amount of porosity at the polymerization time of 74 ° C for 2 hours compared to the polymerization time of 100 ° C for 30 minutes.

The data obtained in this study shows the average and standard deviation of the amount of internal porosity of hot polymerized acrylic resin with different methods, namely sample A group is 11,520 ± 3,547, sample B group is 7,860 ± 3,141 and sample group C is 14,150 ± 17,988. In this study, it can be seen that the average porosity value of the hot polymerized acrylic resin by different methods in sample group B (temperature 25 ° C for 0 '→ 70 ° C for 90' → 100 ° C for 30 ') has the same porosity. slightly compared to sample A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 ') and sample C (temperature 25 ° C for 0' → 74 ° C for 60 '→ 100 ° C for 30 '). This is because if the temperature of the polymerization process does not exceed the boiling point of the monomer, the amount of porosity contained in the acrylic resin will be low, the monomer boiling point is 100.8 ° C.

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