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Different Polymerization Methods for Dentistry Amount Internal Porosities: A Systematic Review

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ABSTRACT

Data were analysed statistically using the Kruskal-Wallis test to see differences in porosity between 3 different polymerization groups in samples A, B and C. Then continued using the Mann Whitney test to see differences in porosity in each sample A, B and C. heat polymerization acrylic resin with different polymerization methods in sample A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 ') compared to sample B (temperature 25 ° C for 0' → 70 ° C for 90 '→ 100 ° C for 30') and sample C (temperature 25 ° C for 0 '→ 74 ° C for 60' → 100 ° C for 30 '). Sample C (temperature 25 ° C for 0 '→ 74 ° C for 60' → 100 ° C for 30 ') had a higher amount of porosity of the hot polymerized acrylic resin with different polymerization methods compared to sample B (temperature 25 ° C during 0 '→ 70 ° C for 90' → 100 ° C for 30 '). There was no significant difference in the amount of internal porosity in the hot polymerized acrylic resin with different polymerization methods in sample A, sample B and sample C.

Keywords: Polymerization Methods, Heat Polymerized Acrylic Resins, Measurement Porosity.

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INTRODUCTION

Acrylic resins have been used in dentistry since the mid-1940s for a variety of purposes such as aesthetic coatings, denture crowns and denture elements, orthodontic appliances, repair materials, and removable denture base materials. Acrylic resin has several advantages, namely aesthetics, colour and texture similar to gingiva, low water absorption, easy processing and repair without laboratory experts. Acrylic resin is an ethylene derivative that contains a vinyl group. Generally, there are 3 types of acrylic resin used in dentistry, namely heat cured acrylic resin, self-cured acrylic resin, and light cured acrylic resin. Acrylic resins that are widely used in the manufacture of denture bases are heat cured acrylic resins. Hot polymerized acrylic resin is still widely used in the manufacture of denture bases because of its advantages including satisfactory aesthetic quality, low water absorption, good thermal conductivity, easy processing and repair without the help of laboratory experts as well as being economical, and biocompatible. However, hot polymerized acrylic resin has the disadvantage of having a low impact strength so that it is easy to fracture if it falls on a hard surface. Research conducted by Sahela Nisar et al in 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 by 70ºC for 90 minutes then raised again. 100ºC for 60 minutes, 25ºC for 0 minutes then set the temperature to 70ºC for 60 minutes, 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.

LITERATURE REVIEW

In this study, this research was conducted with work procedures that can be seen in the chart fig.1.1:

Manufacture Master Plat

The master plate is made of stainless steel with a size of 20 mm x 20 mm x 2 mm as many as 4 pieces.

Manufacture Mould

a. Make a hard gypsum dough with a ratio of 300 gr: 90 ml of water.
b. The dough is stirred with a spatula and made sure that everything is mixed homogeneously.
c. The gypsum dough that has been homogeneous is put into the bottom cuvette that has been prepared while vibrating.
d. The master plate which has been smeared with Vaseline is placed on the dough in a cuvette until the surface of the master plate and the plaster is even.
e. The cast is left to harden for 15-20 minutes until the heat of the cast is gone.
f. After the plaster hardens, the upper surface of the plaster and the master plate is smeared with Vaseline. The top cuvette is attached to the bottom cuvette and filled with gypsum dough (ratio of gip to water 300 grams: 90 ml), then the cuvette is

closed and the top and bottom cuvettes are close contact.

g. After the cast on the upper cuvette hardens, the opened and the master plate is slowly removed mould result is obtained that matches the maste

h. The mould was smeared with could mould separating medium.

Hot Polymerized Acrylic Resin Sampling

a. The polymer and monomer were stirred slowly acrylic pot with a ratio of 23g: 10 ml homogeneous and reached the dough phase. stage the dough will no longer stick to the touc your hands or a spatula.

b. After reaching the dough phase, the dough is put mould, then covered with plastic slope and t cuvette is attached and pressed using a manual p

c. The cuvette was opened and excess acrylic remov then closed again.

d. The cuvette was pressed again using a press un upper and lower cuvettes were in close contact press).

e. The cuvette bolts are fixed and locked to keep t cuvette and the bottom cuvette well adapted.

f. Polymerization process

Polymerization (heating)

a. The polymerization process is carried out inserting the cuvette into a water bath filled w water.

b. b. The heating for the sample group A started room temperature 25º C for 0 minutes a increased the temperature to 74º C for 90 minut then the polymerization process was continued increasing the temperature to 100º C for minutes, after which the water bath was turned and waited until it reached room temperature that the cuvette which contains the sample can removed from the water bath.

c. c. The heating for the sample group B started room temperature 25º C for 0 minutes a increased the temperature to 70º C for 90 minut then the polymerization process was continued by increasing the temperature to 100º C for 30 minutes, after which the water bath was turned off and waited until it reached room temperature so that the cuvette which contains the sample can be removed from the water bath.

d. d. The heating for the sample group C started at room temperature 25º C for 0 minutes and increased the temperature to 70º C for 60 minutes, then the polymerization process was continued by increasing the temperature to 100º C for 30 minutes, after which the water bath was turned off and waited until it reached room temperature for the cuvette which contains the sample can be removed from the water bath.

Polishing

After the sample came out of the cuvette, the excess acrylic was removed and trimmed using a Fraser bur to remove sharp parts, then with pumice powder using a micromotor, after that it was smoothed using 500, 1000 grid sandpaper and emery paper to smooth the surface of the sample.

Measurement

To determine the porosity ratio in the sample, the average porosity measurement was carried out for each sample. Using the formula for mean porous, which is the total number of pores in all viewing areas compared to the number of measurement areas. To see the internal porosity of each sample using a micrograph primo Zeiss star microscope with a magnification of 3000 x, then each sample is divided by 4 viewing areas with a dividing line using a pencil then traced using a microscope, then in each field of view the number of porosity is calculated, after that calculate the average mean porosity that is, the sum of all pores in all viewing areas relative to the total measurement area. Then it will be seen using the percentage in each sample.

Data *Analysis*

Data were analysed statistically using the Kruskal-Wallis test to see differences in porosity between 3 different polymerization groups in samples A, B and C. Then continued using the Mann Whitney test to see differences in porosity in each sample A, B and C.

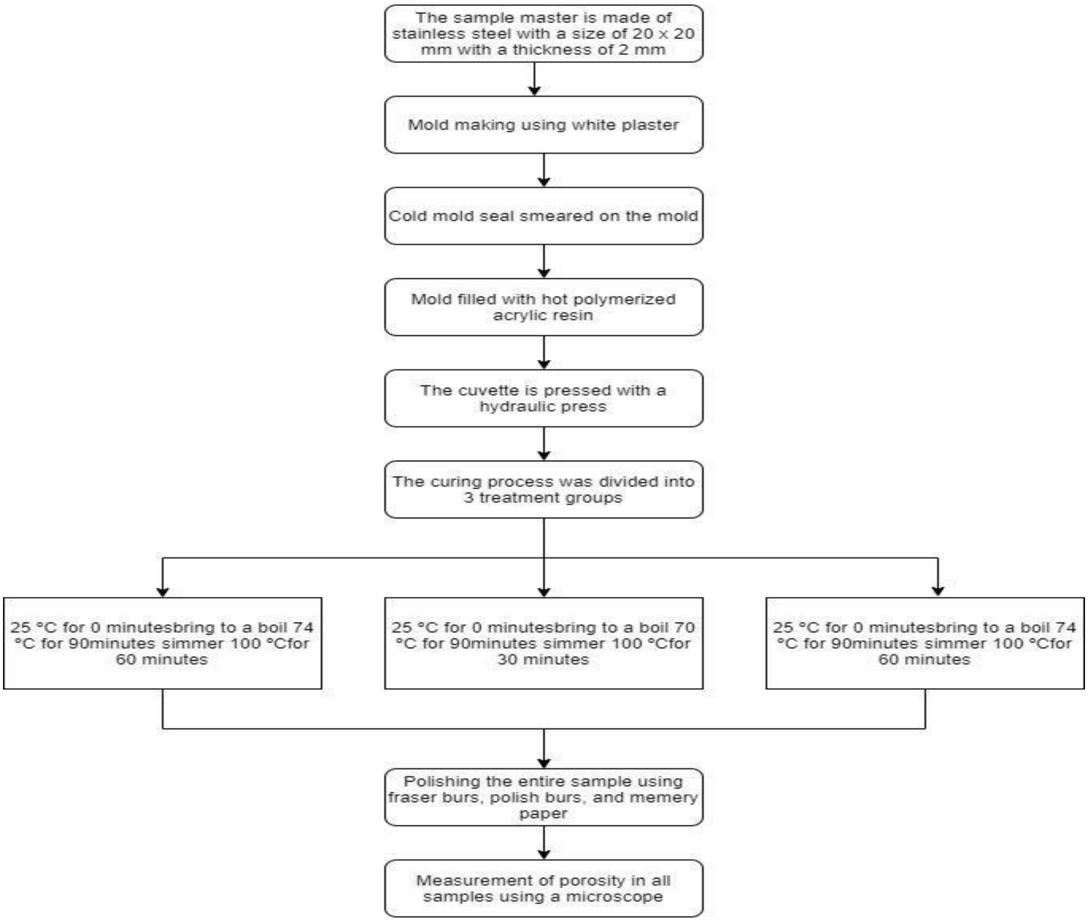

Fig 1. Research Stages in Measuring Amount Internal Porosity

MATERIAL

Sample Criteria

A. Inclusion Criteria
   1. Sample in the form of blocks with a size of 20 mm x 20 mm x 2 mm.
   2. The surface of the polished sample is smooth and shiny.

B. Exclusion Criteria
   1. Sample contaminated with other materials (dirty samples).
   2. Cracked sample.

Operational Definition

1. Hot polymerized acrylic resin is a denture base material which is formed by mixing a powder containing polymer and a liquid containing a monomer which polymerizes by heating.
2. Porosity is the bubble in the surface of the denture base. Polymerization is a series of chemical reactions in which macro molecules or polymers are formed from a number of molecules, namely monomers.

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

No	**Total porosity**		
	specimen **A**	specimen **B**	specimen **C**
1	199,8	5,5	6,4
2	8,8	5,0	5,2
3	4,1	5,6	7,2
4	8,1	8,7	8,1
5	47,3	15,4	64,6
6	13,8	7,3	14,6
7	8,22	7,2	5,0
8	9,25	7,7	11,3
9	10,5	10,5	11,5
10	7,7	5,7	7,6
X ± SD	**31,759 ± 60,317**	**7,860 ± 3,141**	**14,150 ± 17,988**

RESULT AND DISCUSSION

In this result, 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 using the Shapiro-Wilk test

Category	Statistics	Diff	Sig`.
specimen A	.491	10	.000
specimen B	.818	10	.024
specimen C	.520	10	.000

Based on Table 2, the normality test shows that the amount of porosity in sample A, sample B, and sample C is not normally distributed (p> 0.05), so the Kruskal-Wallis test (nonparametric test) is performed to test whether there is a statistically significant difference.

Table 3. Result Kruskal-Wallis

Methods	Number of Porosity
Chi-Square	3.172
Diff	2
Asymp. Sig`.	205

Based on table 3 above, it was obtained p value = 0.205 (p <0.05), it was concluded that there was no statistically significant difference regarding the porosity of hot polymerized acrylic resin with different methods in sample A, sample B, sample C. that Ho (initial hypothesis) is rejected. Then the analysis was carried out using the Mann Whitney test to compare between sample groups.

Table 4. Result *Mann Whitney*

No	Category Specimen	Sig`.
1.	specimen A with specimen B	.069
	specimen A with specimen C	.0364
2.	specimen B with specimen A	.069
	specimen B with specimen C	.449
3.	specimen C with specimen A	.0364
	specimen C with specimen B	.449

From the results of the Mann Whitney test above, it shows that there is no significant difference with the significance value in the sample group A with the sample group B is p = 0.069 (p = <0.05). The comparison between sample group A and sample group C shows the significance value is p = 0.0364 (p = <0.05). In the sample group B with sample group A shows a significance value of p = 0.069 (p = <0.05) which indicates that there is no meaningful difference between groups. The comparison between sample group B and sample group C shows the significance value is p = 0.449 (p = <0.05). In sample group C with sample group A shows a significance value of p = 0.364 (p = <0.05) which indicates that there is no significant difference between groups. The comparison between sample group C and sample group B shows the significance value is p = 0.449 (p = <0.05).

The results of this study indicate that there is a difference in the amount of internal porosity in 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 31.759 in the sample group. B (temperature 25 ° C for 0 '→ 70 ° C for 90' → 100 ° C for 30 ') is 7,860 and 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 group A was 31,759 ± 60,317, sample group B was 7,860 ± 3,141 and sample group C was 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.

Then there is sample group B, the difference in the amount of porosity in the acrylic resin is not 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 In accordance with Moosa R's research (2012) on the effect of the polymerization method of acrylic resin on porosity with temperature and different times which reveal that the polymerization time is fast, the porosity value of the acrylic resin will be more.

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

a. There was a high amount of porosity in the hot polymerized acrylic resin with different polymerization methods in sample A (temperature 25 ° C for 0 '→ 74 ° C for 90' → 100 ° C for 60 ') compared to sample B (temperature 25 ° C) for 0 '→ 70 ° C for 90' → 100 ° C for 30 ') and sample C (temperature 25 ° C for 0' → 74 ° C for 60 '→ 100 ° C for 30').
b. Sample C (temperature 25 ° C for 0 '→ 74 ° C for 60' → 100 ° C for 30 ') had a higher amount of porosity of the hot polymerized acrylic resin by different polymerization methods compared to sample B (temperature 25 ° C during 0 '→ 70 ° C for 90' → 100 ° C for 30 ').
c. There was no significant difference in the amount of internal porosity in the hot polymerized acrylic resin with different polymerization methods in sample A, sample B and sample C.

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