

Effect of Curing Mode on the Adaptation Accuracy of Heat Cured and Microwave Processed Acrylic Resin: An In Vitro Study

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ABSTRACT

Background: Aims and objective: Poly-methyl-metacrylate resin has been used commonly for denture bases. Polymerisation shrinkage and release of thermal stresses are the major disadvantages exhibited of these materials. The present study was conducted to check the effect of curing mode on the adaptation accuracy of heat cured and microwave processed acrylic resin.

Methodology: 30 maxillary acrylic bases (2 mm thick) were made on cast model. These specimens were divided into 3 groups. Group 1: control, conventional heat cure PMMA cured by water bath method (short cycle) Group 2; Conventional heat cure PMMA samples cured by water bath method (Long cycle) Group 3; microwave acrylic resin samples cured by microwave energy (350 W for 6 min). The base/ cast sets were sectioned transversally in the posterior palatal seal zone. The measurements were made at the right marginal limit, left marginal limit, right ridge crest, left ridge crest and the palatal midline. The existence of gaps between the casts and acrylic was assessed using a stereomicroscope.

Results: There was no significant difference between conventional heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy.

Conclusion: The greatest discrepancy was seen in conventional heat cure PMMA samples cured by water bath (short cycle) and lowest discrepancy was seen with the microwaveable acrylic resin samples cured by microwave energy (350 W for 6 min).

Keywords: Adaptation accuracy Microwave, Denture base material, Poly-methyl-metacrylate.

INTRODUCTION

Denture bases for conventional or implant supported prosthesis usually are made of methacrylate-based polymers activated by thermal energy delivered by different methods eg immersion in hot water bath, microwave irradiation and injection moulding techniques. ¹ Takamata

T, Setcos JC reported Poly-methyl-metacrylate have optimal physical properties and excellent esthetics with relatively low toxicity compared to other plastic denture base materials. ² Despite its popularity its far from ideal, polymerization shrinkage and release of thermal stresses are major disadvantage of this material³. The combination of

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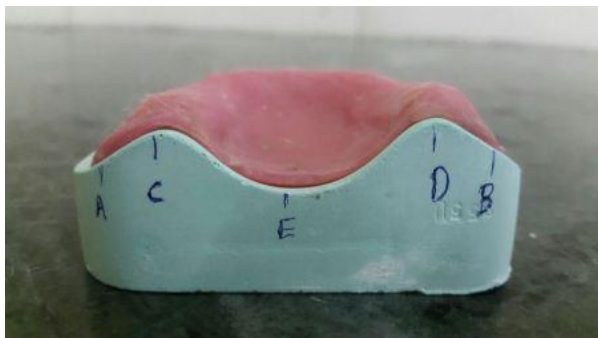


Fig 1: The gap between maxillary denture base and cast at the right marginal limit,(A)left marginal limit(B),right ridge crest(C) ,left ridge crest(D) and the palatal midline(E).

polymerization shrinkage and distortion due to the thermal stresses affects the adaptation accuracy of denture bases to underlying tissue and creating a microgap^{4,5}. The problems associated with the compression moulding technique increase the gap between the denture base and the underlying mucosa ,compromising the fit of dentures.⁶Therefore acrylic resin and processing methods have been modified to improve physical and chemical properties of denture bases. The microwave disinfection at 690 W for 6 min promoted significant increase of baseplate distortion in a denture resin polymerized by microwave energy but not when same resin was polymerized by conventional water bath⁷ . The results of various studies have been mixed and conflicting. The present study was conducted to check the effect of curing mode on the adaptation accuracy of heat cured and microwave processed acrylic resin comparatively evaluate

Aims and Objectives

To check adaptation accuracy in conventional heat polymerized resin cured by water bath technique (short cycle).

To check adaptation accuracy in conventional heat polymerized resin cured by water bath technique (long cycle)

To check adaptation accuracy in microwave acrylic resin cured by microwave energy.

To comparatively evaluate adaptation accuracy of conventional heat resin cured by water bath (short

and long cycle) and microwave resin cured by microwave energy .

MATERIALS AND METHOD

Silicone rubber base impression was made of maxillary arch and poured with Type IV dental stone to obtain cast model.⁸ 30 maxillary acrylic bases (2mm thick) were made on cast model DPI heat cure material and Acron MC microwaveable resin was used for present study The specimens divided into 3 groups.

Group 1: control, conventional heat cure PMMA cured by water bath method (short cycle)

Group 2; conventional heat cure PMMA samples cured by water bath method (Long cycle) Group 3; microwave acrylic resin samples cured by microwave energy(350 W for 6 min)

Curing procedure for Group 1: control, conventional heat cure PMMA samples cured by water bath (short curing cycle)

The prepared wax models were invested in the flask following the manufacturer's instructions for water – powder ratio, mixing time and setting time. Thereafter dewaxing was done by immersing in boiling water for 5 minutes. A mixture of polymer and monomer in the ratio of 3:1 by volume was proportioned prior to mixing.Once the mix reached the dough consistency it was kneaded and then packed in the mould. The flasks were clamped and closure was done under pressure of 20 KN and kept for 30 mins. The acrylic resin was processed in a water bath curing tank for one hour thirty minutes at 74 degree C and another 1 hour at 100 degree C and thereafter flasks were then kept at room temperature for one hour.

A total of 10 test specimens were prepared using this procedure. Curing procedure for Group 2 conventional heat cure PMMA samples cured by water bath (long curing cycle)The prepared wax models were invested in the flask following the manufacturer's instructions for water – powder ratio, mixing time and setting time. Thereafter dewaxing was done by immersing in boiling water for 5 minutes. A mixture of polymer and monomer in the ratio of 3:1 by volume was proportioned prior to mixing.Once the mix reached the dough consistency it was kneaded and then packed in the

Table 1: Comparative mean marginal discrepancy between all groups at the right marginal limit, left marginal limit, right ridge crest, left ridge crest and the palatal midline.

	Right marginal limit	Left marginal limit	Right Ridge crest	Left Ridge crest	Palatal midline
Group 1	2.600±1.598	2.700±1.625	0.800±0.329	1.010±0.899	2.012±1.892
Group 2	1.020±0.674	1.400±0.912	0.040±0.023	0.004±0.008	0.421±0.335
Group 3	0.900±0.489	1.100±0.608	0.030±0.019	0.002±0.012	0.320±0.299
p-value ^a	< 0.001*	0.009*	< 0.001*	0.001*	0.003*
Group 1 vs 2 ^b	0.006*	0.041*	< 0.001*	0.002*	0.010*
Group 1 vs 3 ^b	0.003*	0.010*	< 0.001*	0.001*	0.006*
Group 2 vs 3 ^b	0.964 [#]	0.825 [#]	0.995 [#]	0.823 [#]	0.978 [#]

mould. The flasks were clamped and closure was done under pressure of 20 KN and kept for 30 mins. The curing temperature is programmed to 100 degree C for 8 hours and then flasks were then kept at room temperature for one hour. A total of 10 test specimens were prepared using this procedure

Curing procedure for Group 3 Microwave acrylic resin Acron MC samples cured by microwave energy

The resin was mixed, and investing done in special flask. Curing was done in domestic microwave with time power of 350 W for 6 min⁹. A total of 10 test specimens were prepared using this curing technique. Thus each group consists of 10 test samples and total of 30 samples from 3 study groups.

Measurement of adaptation accuracy in Test specimens

The base/ cast sets were sectioned transversally in the posterior palatal seal zone. The measurements were made at the right marginal limit (A), left marginal limit, right (B) ridge crest (C), left ridge crest (D) and the palatal midline (E) (FIG 1). The existence of gaps between the casts and acrylic was assessed using a stereomicroscope.

Statistical Analysis:

The statistical analysis were done using Kruskal-wallis test and Mann-whitney U test

Level of Significance (p-value)

P-value < 0.05 - Significant

RESULTS

The comparison of the mean marginal discrepancy was compared between the groups 1, 2 and 3 at Right marginal limit, Left marginal limit, Right Ridge crest, Left Ridge crest and Palatal midline using the Kruskal-wallis test. There was a significant difference in the mean marginal discrepancy between the groups 1, 2 and 3 at all the margins.

The post-hoc inter-group comparison was done between the groups 1, 2 and 3 at Right marginal limit, Left marginal limit, Right Ridge crest, Left Ridge crest and Palatal midline using the Mann-whitney U test. At all the margins, the mean marginal discrepancy was significantly more among group 1 in comparison to groups 2 and 3. Whereas, there was no significant difference between groups 2 and 3.

DISCUSSION

Poly-methyl-metacrylate has been most commonly material used since decades. It has excellent esthetic properties, strength, low water sorption, low solubility, lack of toxicity and is one of the material of choice^{10,11} Anthony, DH, FA Peyton¹² reported that the accurate fit of denture base is a principal criterion in the physical mechanism of complete denture retention. The polymerization shrinkage and distortion due to the thermal stresses affects the adaptation accuracy of denture base to underlying tissue, and thereby creating a microgap.

Jafar Gharechahi ,Nafiseh Asadzadeh,Foad Shahabian, Maryam Gharechan ¹³ stated that the acrylic specimen produced by injection moulded technique exhibited less dimensional changes compared to those produced with conventional water bath technique. The curing shrinkage was compensated by water storage time decreasing dimensional changes. Webb et al ⁹ stated that microwaving dentures at 350 W during 6 min may be more effective method of sterilization than soaking denture in 0.02 % sodium hypochlorite. Burns et al¹⁴ reported that specimens made from three different denture base material had excellent stability after 15 min at 650 W of microwave radiation. The results of various studies by researches were mixed hence present study was conducted to check the effect of curing mode on the adaptation accuracy of heat cured and microwave processed acrylic resin.

The mean marginal discrepancy was significantly more in control, conventional heat cure PMMA cured by water bath method (short cycle) in comparison to conventional heat cure PMMA samples cured by water bath method (Long cycle). The probable reason may be that high residual monomer in short curing cycle have deleterious effect on properties of denture base resin thereby affecting their dimensional stability.

There was no significant difference between conventional heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy(350 W for 6 min) The mean marginal discrepancy was significantly more among control, conventional heat cure PMMA cured by water bath method (short cycle) in comparison to microwave acrylic resin samples cured by microwave energy(350 W for 6 min). The probable reason may be that the dimensional stability may be influenced by combined effect of type of resin/polymerized technique and microwave irradiation setting.

CONCLUSION

1. The greatest dimensional discrepancy were seen in conventional heat cure PMMA samples cured by water bath (short cycle)

2. The lowest dimensional discrepancy was seen with the microwaveable acrylic resin samples cured by microwave energy (350 W for 6 min)

3. There was no significant difference of dimensional discrepancy between conventional heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy(350 W for 6 min).

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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