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DIMENSIONAL ACCURACY OF ACRYLIC RESIN DENTURE BASES; HIGH STRENGTH HEAT CURED VERSUS MICROWAVE PROCESSED ACRYLIC RESIN– AN IN VITRO STUDY.

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Manuscript

Dimensional accuracy of acrylic resin denture bases; high strength heat cured versus microwave processed acrylic resin**.**

ABSTRACT

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 evaluate and compare Dimensional accuracy of acrylic resin denture bases;high strength heat cured versus 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, high strength heat cure PMMA cured by water bath method (short cycle) Group2; high strength heat cure PMMA samples cured by water bath method (Long cycle) Group 3; microwave acrylic resin samples cured by microwave energy (550 Wfor 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 high strength heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy.

Conclusion: The greatest discrepancy were seen in high strength 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 (550 Wfor 6 min)

Key words: Dimensional accuracy, Microwave, Denture base material, Poly-methyl-metacrylate

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Introduction

Denture bases for high strength 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 iiradiation 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

disadvantage of this material[3.].The combination of polymerization shrinkage and distortion due to the thermal stresses affects the dimensional 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. [6]Therefore 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 high strength water bath[7]. The results of various studies have been mixed and conflicting. The present study was conducted to evaluate and compare Dimensional accuracy of acrylic resin denture bases; high strength heat cured versus microwave processed acrylic resin

Aims and Objectives

1. To evaluate dimensional accuracy in high strength heat polymerized resin cured by water bath technique (short cycle).
2. To evaluate dimensional accuracy in high strength heat polymerized resin cured by water bath technique (long cycle)
3. To evaluate dimensional accuracy in microwave acrylic resin cured by microwave energy.
4. To comparatively evaluate dimensional accuracy of high strength heat resin cured by water bath (short and long cycle) and microwave resin cured by microwave energy.

Material and Methodology:

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 Trevalon high strength heat cure material and Acron MC microwaveable resin was used for present study The specimens divided into 3 groups**.**

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

Group 2; high strength heat cure PMMA samples cured by water bath method (Long cycle) Group 3 ; microwave acrylic resin samples cured by microwave energy(550 Wfor 6 min)

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Curing procedure for Group 1: control, high strength 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 3 minutesA 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 high strength 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 3 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 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 550 Wfor 6 min[9]

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 dimensional 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**

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❖ 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. **(Table 1)**

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 2and 3.

DISCUSSION

Poly-methyl-metacrylate has been most commonly material used since decades.It has excellent esthetic properties, strengh,low water sorption ,low solubilty,lack of toxicity and is one of the material of choice [10,11] **Anthony,DH,FA Peyton**[12] 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 dimensional accuracy of denture base to underyling 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 accuracy compared to those produced with high strength water bath technique. The curing shrinkage was compensated by water storage time decreasing dimensional changes. **Webb et al** [9] stated that microwaving dentures at 550 W during 6 min may be more effective method of sterilization than soaking denture in 0.02 % sodium hypochlorite .**Burns et al**[14] reported that specimens made from three different denture base material had excellent stability after 13 MIN at 650 W of microwave radiation .The results of various studies by researches were mixed hence the present study was conducted to evaluate and compare Dimensional accuracy of acrylic resin denture bases;high

strength heat cured versus microwave processed acrylic resin

The mean marginal discrepancy was significantly more in control, high strength heat cure PMMA cured by water bath method (short cycle) in comparison to high strength 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 high strength heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy (550 Wfor 6 min).

The mean marginal discrepancy was significantly more among control, high strength heat cure

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PMMA cured by water bath method (short cycle) in comparison to microwave acrylic resin samples cured by microwave energy (550 Wfor 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 high strength 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 (550 Wfor 6 min)
3. There was no significant difference of dimensional discrepancy between high strength heat cure PMMA samples cured by water bath method (Long cycle) and microwave acrylic resin samples cured by microwave energy (550 Wfor 6 min)

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LEGENDS OF TABLE AND FIGURE

TABLE I: 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

Figure 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 midlinine(E)

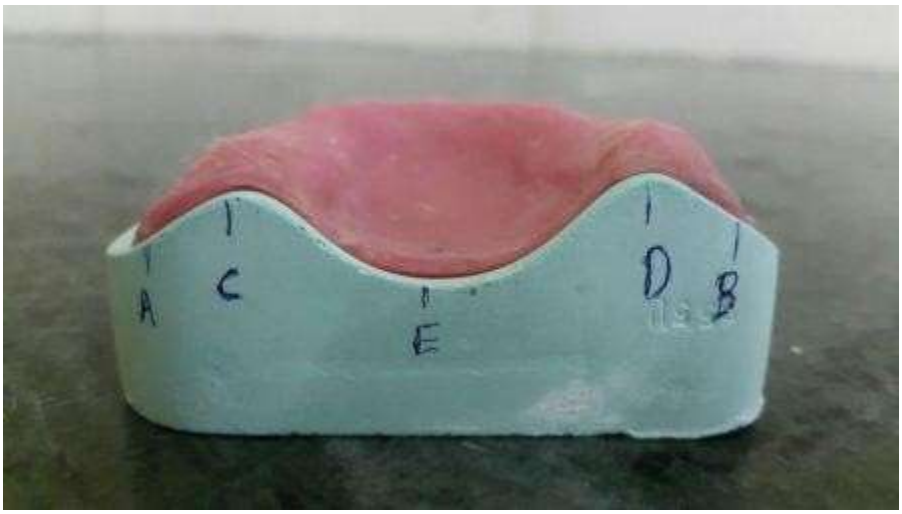

FIGURE 1

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TABLE I

	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 1vs 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[#]

*** Significant difference**

[#] Non-significant difference

[a] Kruskal-wallis test

[b] Mann-whitney U test