



Effect of Resin Stages on the Dimensional Accuracy of Denture base cured by long and short curing method in a conventional water bath

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Abstract

Acrylic resin is the most widely used material in prosthetic dentistry and its dimensional accuracy is most important factor in successfulness denture constructor.

The aim of this study was to investigate the dimensional changes of denture base acrylic cured by long and short curing method by using conventional water bath.

60 maxillary wax bases were made and randomly assigned in 3 groups specimens according to the stringy, dough like and rubbery stages of the acrylic resin cured by:

1-long curing cycle: curing the resin at 74 C° for 9 hours.

2-Short curing cycle: processing the resin at 74 C° for 1 ^{1/2} hour and at 100 C° for 1/2 hour. Results were submitted to ANOVA and Turkey's test and it showed that in short curing cycle, the dough like stages presented values (0.193 mm) with statistically significant difference (P<0.05) when compared with the stringy (0.246mm) and rubbery (0.240 mm) stages.

While for the long curing cycle the dough stage presented values (0.199mm) with statistically significant difference (P<0.05)when compared with stringy (0.230mm) and rubbery (0.239mm) Stages, the best results were observed in section A and the worst was in section C.

Introduction

One of the most widely used materials in prosthetic dentistry is acrylic resin.

The acrylic denture base is responsible for artificial teeth fixation ,stability and distribution of biting forces.⁽¹⁾In addition to the dimensional changes which occur during polymerization shrinkage ,many factors may influence the base dimensional accuracy, such as the flasking method used and time – temperature correlation during polymerization process.^(2,3)

An important and essential factor in the retention and stability of the denture is the dimensional changes may happen due to polymerization shrinkage.^(4, 5, 6)

These changes may be partially compensated by water absorption ⁽⁷⁾, the resilience of the mucosa ⁽⁸⁾, and by the saliva film that formed between denture base and the soft tissues. ^(9, 10)

(Huggett ,et al) ⁽¹¹⁾ Mentioned that curing cycle had the greatest effect on the dimensional accuracy of the denture base, and this dimensional changes that occur may not be fully

compensated after the resin base processing.⁽¹²⁾

The most significant linear shrinkage usually occurs in the palatal region of the maxillary denture, resulting in a gap between the palatal zone and the processed denture.⁽¹²⁾

In the resin curing procedure, the combination of polymerization shrinkage, thermal contraction during flask cooling, and strain accompanying stress release during deflasking causes diminished adaptation of the denture.⁽⁹⁾

Thus the purpose of this study was to evaluate dimensional changes of denture base polymerization by conventional acrylic stages flaked by the conventional method using long and short curing method.

Materials and Methods

A mold of an edentulous maxillary arch without irregularities in the alveolar ridge walls was prepared from silicone material (n-so, Major). Using the mold to cast were poured in class III dental stone (Geastone, GESSODURO, tipo, (GR), Italy), using 3: 1 water to powder according to the manufacture instructions. (figure 1)

A uniform denture base pattern was made on each stone cast with a 1^{1/2} mm thickness of base plate wax (T.P.REGULAR Major, Italy). (figure 2)

The casts with wax patterns were flaked in dental stone following the conventional flaking procedure. The stone casts were randomly divided into three groups of 60 specimens according to stringy, dough like and rubbery stage trial groups.

The denture bases were flaked in the lower part of traditional brass flaks with class II dental plaster (Iraq). Petroleum jelly was used as a separating medium between the plaster in the lower part of the flask and the class III dental stone used in the upper

portion. After 1 hour the flasks were placed in boiling water and liquid detergent(washing liquid).

Two coats of sodium alginate (dantanum, Germany) were used as a mould separator.

Standard PMMA (Heat-Curing Resin, Major) was used with monomer: polymer ratio of 1:3 (by volume). The recommended mixing ratio of 37.5 g powder to 15 ml liquid was used according to manufactures instructions for each flask pressing. The prepared dough was then packed according to one of the trial groups (20 stringy stage, 20 dough like stage and 20 rubber stage).

A plastic sheet was used as a separating medium between the gypsum and the resin during the initial flaking closure, the flask was opened, the plastic sheet removed and the acrylic resin excess was trimmed. The final closure using a hydraulic press (Lina H2000, Germany) was made with a load of 1.250 Kg for 5 minutes.

After final closure, the flasks were transferred to assembly during denture processing. The flasks were immediately put in water and kept at 74 C° for 1^{1/2} hour and then 100 C° for 1/2 hour.⁽¹³⁾

While for the long curing method the flasks were kept at 74 C° for 9 hours.⁽¹⁴⁾

After curing, the flasks were removed and allowed to bench cool before the bases were deflaked, trimmed, and fixed on the corresponding casts with instantaneous adhesive (Super Bonder, China) placed on the ridge crest of the stone cast. The resin base with stone casts were transversally sectioned in three portions corresponding to the distal of canines (1), mesial of first molars (2), and posterior palatal zone (3). The gap between the resin base and stone cast was measured in five points at the right and left ridge crests,

at the midline ,and at right and left marginal limits.(finger 3)

Each measurement was repeated three times, and the average was used as the liner gap distance for that point. The measurements were made at five points for each one of three sections, until the completion of five samples averaged together in each individual section .The procedure was repeated for all groups. The results were submitted to ANOVA and Turkey's test at a level of significance of 5%.

Results

In table (1) we can see dimensions of the gap between the base and the stone cast influenced by the stage of the acrylic resin stage by two curing method. A comparison of the dimensional change values in relation between the stringy , dough like and rubbery stages using short curing cycle revealed statistical significant differences ($P < 0.05$) when compared with the long curing cycle the dimensional changes smaller with the short curing cycle .

The comparison of the dimensional changes values occur in the stringy, dough and rubbery stages in short curing cycle showed that the dough stage is the lowest statistical difference ($P < 0.05$) when compared to the stringy and rubbery stages.

While in long curing cycle dough stages presented values (0.199mm) , with statistical significant difference ($P < 0.05$) when compared with stringy (0.220mm) and rubbery (0.250mm) stages .So acrylic resin curing in the dough like stage in both curing cycle resulted in smaller dimensional change values when compared to stringy and rubbery stage in both curing cycle.

In table (2) We can see the dimensional change values of the individual section 1, 2 and 3 which

showed no statistical significant differences ($P > 0.05$)

In both curing cycle section 3 and in the section 2 dough like and rubbery stage presented values with no statistical difference ($P > 0.05$) when compared to stringy consistencies and the rubbery stage were similar to both stages.

In table (3) the dimensional change values showed statistically significant differences ($P < 0.05$) the better accuracy were seen in section (1)

In both curing methods, while in section (3) we can see the bigger dimensional inaccuracy in both curing cycle.

In table (4) the dimensional change values in relation to the section and stage interaction. In the rubbery, dough like and stringy stages the bigger dimensional inaccuracy was showed in section (3) . The better accuracy was seen in section (1) in both curing methods.

Discussion

The result of this study indicate that the acrylic resin stage- curing methods interaction was a significant factor in determining the magnitude of the dimensional changes that occurred during denture base curing . A comparison of the dimensional change due to resin stages used in both methods revealed that the dough like stage presented smaller values with statistically significant difference when compared with the stringy and rubbery stages. The results showed that the dough like stage is most suitable for resin packing in both curing cycle, The gap decrease observed in the short curing method may be able to contribute to the improvement of the denture retention and to increase the chewing function of the patient . The acrylic resin stage established in this study to start of the curing cycle was a

significant factor in the magnitude of the dimensional changes occurred during denture base polymerization⁽¹⁵⁾

These results also indicate that the dimensional accuracy is an inevitable shortcuring of the acrylic resin and one of the factors that may contribute to gap discrepancy in denture fabrication, independently dimensional change values obtained with the dough like consistency were smaller than those obtained with stringy and rubbery stages in both curing methods, these results were in agreement with **peyton**.⁽¹⁵⁾ and **sanders et al** 1991⁽¹⁸⁾.

The dimensional changes that occurs in this study indicates that variations in curing technique did not significantly alter the pattern of dimensional acrylic resin behavior which is may be due to the decrease in the molecular weight of the resulting polymer chains and this was in agreement with **Harman .I.M, 1949**⁽¹¹⁾ and **ANUSAVICE,k.J.,1996**⁽³⁾

The magnitude of the acrylic resin dimensional changes that occurs in section 3 (posterior palatal seal area) was the greatest in both curing cycles this may be attributed to the fact that polymerization technique influence the internal stresses that produced by different coefficients of the thermal expansion of gypsum and acrylic resin and this goes with the study of Woelfel et al, 1965 (22). thus , although acrylic resin is the most commonly used material in dental construction it is subject to polymerization shrinkage and distortion .the shrinkage resulting from the polymerization reaction is not uniform ,being more evident on the palate of the maxillary denture and will be poorly composted after resin base processing .

Conclusions

The results of this investigation indicates that flasking of acrylic resin

in the dough like stage using short curing method demonstrated less denture base discrepancy when compared to flasking at stringy and rubbery stages for both curing cycles .the greatest denture bas dimensional changewas found on the palatal posterior seal with all acrylic resin stages and packing methods .

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Figure 1: Raber mold (stone cast)



Figure 2:Wax at the Stone Cast

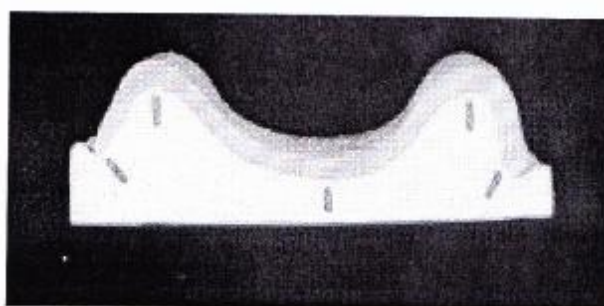


Figure3:points in the transverse sections used to determine the dimensional changes in the base –stone cast

Table -1- Dimensional change means (mm of the denture base in relation to acrylic resin stage curing method).

Curing method	Resin Stage		
	Dough like	Stringy	Rubbery
Short curing cycle	0.193(0.057)	0.246(0.30)	0.240(0.38)
Long curing cycle	0.199(0.050)	0.220(0.049)	0.250(0.031)

Table (2) Dimensional change means (mm) of the denture base in relation to curing (Long and short) methods in resin stages independently of the sections.

Resin stage		Section 1	Section 2	Section 3
Short curing cycle	dough like	0.159(0.005)	0.188(0.020)	0.184(0.008)
	rubbery	0.174(0.018)	0.210(0.022)	0.188(0.014)
	stringy	0.188(0.005)	0.230(0.007)	0.184(0.008)
Long curing cycle	dough like	0.155(0.005)	0.185(0.020)	0.180(0.038)
	rubbery	0.169(0.040)	0.205(0.019)	0.182(0.015)
	stringy	0.188 (0.038)	0.225(0.006)	0.182(0.015)

Table (3) Dimensional change (mm) in the denture base in relation to section independent of the acrylic resin stages in both packing methods.

Section	Short Curing		Long Curing
1	0.155(0.005)	1	0.165(0.052)
2	0.185(0.020)	2	0.197(0.04)
3	0.188(0.038)	3	0.202(0.037)

Table (4):Dimensional changes values (mm) in relation to the section and stage interaction .

	Section	Rubbery	S.d	Stringy	S.d	Dough like	S.d
Short Curing Method	1	0.179	(0.018)	0.188	(0.003)	0.159	(0.005)
	2	0.210	(0.0022)	0.230	(0.007)	0.188	(0.020)
	3	0.188	(0.014)	0.184	(0.008)	0.184	(0.008)
Long Curing Method	1	0.184	(0.008)	0.180	(0.018)	0.165	(0.006)
	2	0.220	(0.017)	0.225	(0.006)	0.184	(0.008)
	3	0.210	(0.0022)	0.188	(0.003)	0.184	(0.008)