

# Evaluation of Dimensional Changes in Denture Base Resins in Different Storage Medium

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### Article Info

Volume 83

Page Number: 2165 - 2171

Publication Issue:

July-August 2020

### Abstract:

The dimensional changes which take place in heat cure acrylic resins are shrinkage and expansion which influences the fit and occlusal relationship of the denture with the underlying oral mucosa. Despite the fact that acrylic resin polymer is known for its phenomenal properties, it has its own particular drawbacks and is not perfect in all its angles and one of these is dimensional change after processing was completed. The aim of the study was to determine linear dimensional changes of commercially available heat cure acrylic resins in four liquid medium. This in-vitro experimental study was conducted on four types of liquid medium (water, saline, artificial saliva, vinegar) with heat cure acrylic resins. Based on the number of mediums, five denture bases were determined for each group (N=20). Hence, each medium was allotted 5 denture bases which was 20 dentures in total. The dentures were allowed to be stored in the mediums for 4 weeks where every 2 days the dentures were placed in the cast were measured using digital vernier caliper to check for any distortion. The denture bases were measured in the posterior-palatal region, the interface between the cast and the denture . After four weeks, all the measurements that were taken, were compared with the base measurements, and analyzed. The data showed the dentures stored in vinegar and saline contracted 0.052mm and 0.040mm respectively and the dentures which were stored in water and artificial saliva contracted 0.031mm, 0.015mm respectively. A statistically significant difference between the storage media was observed ( $p < .05$ ). Within the limitations of this study, water and artificial saliva were the best mediums to be used as a storage medium.

### Article History

Article Received: 06 June 2020

Revised: 29 June 2020

Accepted: 14 July 2020

Publication: 25 July 2020

**Keywords:** Dentures, storage media, dimensional changes.

## INTRODUCTION

The utilization of acrylic resin as a denture base material since 1937 has reformed the dentistry hugely.

It can be utilized with a straight forward strategy for the development of dentures.

Resin polymers have been presented as denture base materials and these denture bases are made utilizing polymethyl methacrylate (PMMA). These materials have ideal physical properties and fantastic esthetics with moderately low toxic quality, adequate mechanical strength low toxicity, easiness of repair and can be cured by simple procedures contrasted with other denture base materials, therefore, PMMA has been the most commonly used for fabricating denture base since it was developed in the mid-1945 (Peyton et al., 1953).

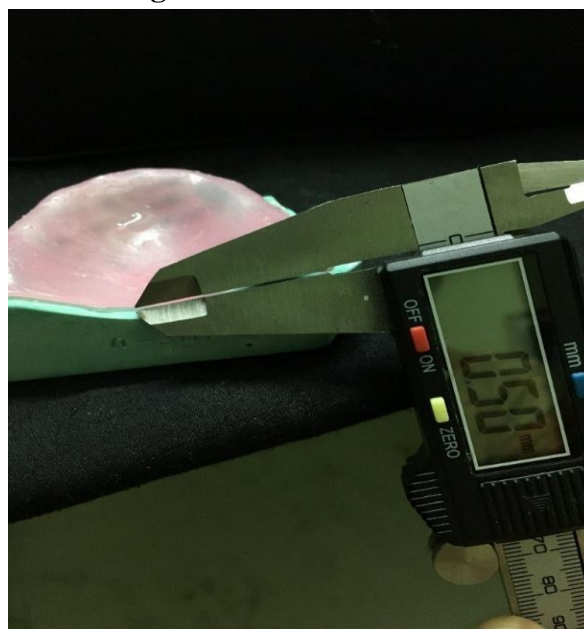
It is well known that denture should be stored in the water in order to minimize distortion and shrinkage, when they are once removed from the mouth. However, it was not known shrinkage was occurred in certain pattern of form when denture was kept in dry condition, nor which portion of the denture should be watched carefully, if the patient who stores his denture in the air comes and want to relieve discomfort due to his denture.(Cho & Lee, 2020)

Exact duplication of trial denture into the final prosthesis is the coveted point amid handling in the lab. In any case, certain properties like dimensional errors of the materials trade off the achievement of this objective ideally. Consequently, a satisfactory medium ought to be chosen for storage of denture with a specific end goal to limit the distortion for dependable utilization. So it is vital to find what sort of storage medium can be prescribed keeping in mind the end goal to avert dimensional changes of the denture. Considering the importance of dimensional changes occurring during storage, the present study was undertaken to determine linear dimensional changes of commercially available heat cure acrylic resins in four liquid mediums.

## MATERIALS AND METHOD

This in-vitro experimental study was conducted on four types of liquid medium (water, saline, artificial saliva, vinegar) with heat cure acrylic resins. Based on the number of mediums, five denture bases were determined for each group (N=20). Hence, each medium was allotted 5 denture bases which was 20 dentures in total [Fig 1].

**Fig 1:** Denture base in cast.

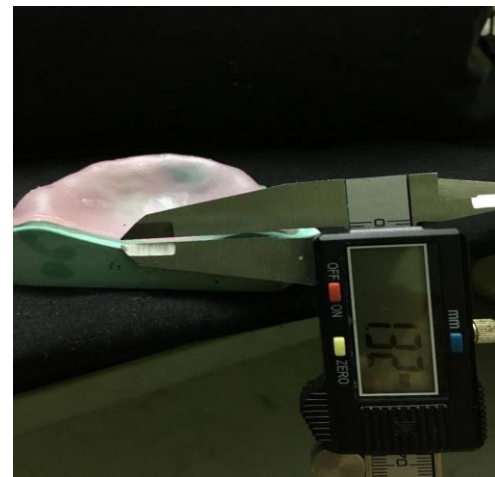
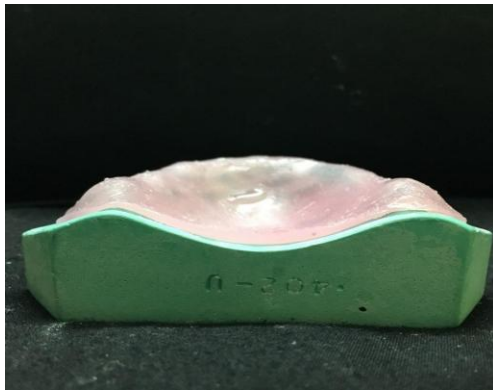


The fabricated denture bases were stored into following storage environments: water, saline, artificial saliva, vinegar. Fusayamameyer Artificial saliva was used for this study. It was prepared in the Biochemistry Department, Saveetha Dental College. Saline and water mediums were kept at room temperature whereas artificial saliva and vinegar mediums were stored at refrigerator temperature. The dentures were allowed to be stored in the mediums for 4 weeks where every 2 days the dentures were placed in the cast were measured using digital vernier caliper to check for any distortion. The denture bases were measured in the posterior-palatal region, the interface between the cast and the denture [Fig 2,2A,2B,2C,2D].

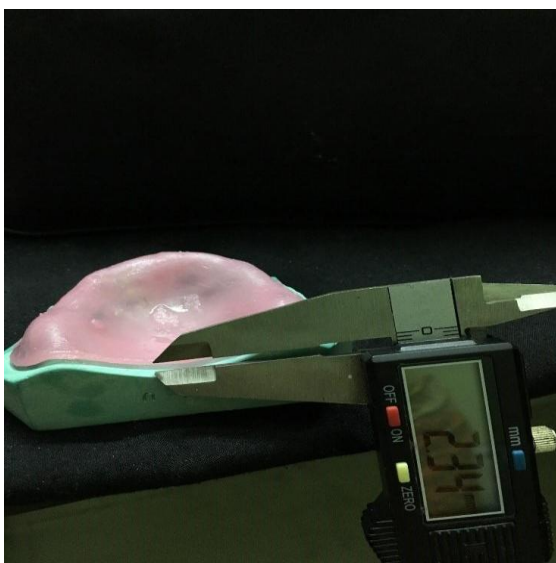
**Fig 2:** Denture bases in different storage medium.



**Fig 2A:** Distortion of denture base stored in water measured with digital caliper.

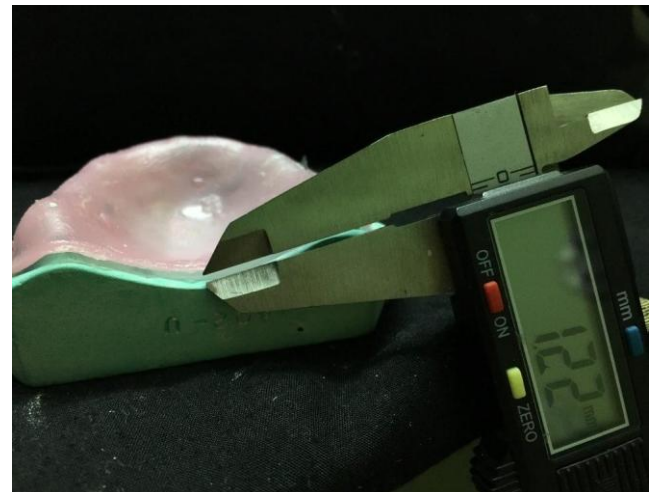


**Fig 2B:** Distortion of denture base stored in artificial saliva.



**Fig 2C:** Distortion of denture base stored in saline.

**Fig 2D:** Distortion of denture base stored in vinegar.



P value <.05 [ANOVA]

After four weeks, all the measurements that were taken, were compared with the base measurements

and analyzed by one way ANOVA using SPSS software version 20 at 5% significance.

Table-1 represents the dimensional changes of measured dentures in four different storage mediums after every two days for four weeks.

## RESULTS

Table I Dimensional changes of denture bases

Days	Water		Artificial saliva		Saline		Vinegar	
	Dimensional change measured at posterior palatal region(Mean)	(SD)	(Mean)	(SD)	(Mean)	(SD)	(Mean )	(SD)
2nd day	0.000mm	0.209	0.000mm	0.274	0.000mm	0.250	0.000mm	0.246
4th day	0.002mm	0.145	0.000mm	0.155	0.003mm	0.210	0.005mm	0.310
8th day	0.009mm	0.349	0.002mm	0.593	0.10mm	0.453	0.012mm	0.398
16th day	0.019mm	1.013	0.010mm	0.379	0.020mm	0.676	0.020mm	0.523
20th day	0.022mm	0.149	0.012mm	0.416	0.028mm	0.761	0.028mm	0.512
25th day	0.028mm	0.637	0.013mm	0.511	0.033mm	0.528	0.033mm	0.687

30th day	0.031mm	1.000	0.015mm	0.721	0.040mm	0.947	0.052mm	0.841
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To determine the difference in each sample before and after storage in the liquid mediums, one way ANOVA was used which is shown in Table 1. The data showed the dentures stored in vinegar and saline contracted 0.052mm and 0.040mm respectively and the dentures which were stored in water and artificial saliva contracted 0.031mm, 0.015mm respectively. A statistically significant difference between the storage media was observed ( $p < .05$ )

## DISCUSSION

The dimensional changes which take place in heat cure acrylic resins are shrinkage and expansion which influences the fit and occlusal relationship of the denture with the underlying oral mucosa. (Skinner & Cooper, 1943) Despite the fact that acrylic resin polymer is known for its phenomenal properties, it has its own particular drawbacks and is not perfect in all its angles and one of these is dimensional change after processing was completed. Dimensional change of denture base resin can be occurred by curing shrinkage and expansion through water absorption, and other former studies stated that dimensional change would be a result of polymerization shrinkage, thermal shrinkage, internal stress release, water absorption, and dry shrinkage (Mustata et al., 2013).

The denture base after curing may have shrunk linearly as much as approximately 0.5%. It could lead distortion of the denture, and although this shrinkage may be compensated with expansion by water absorption, this change would result in poor adaptation of the denture to its tissue, and decrease of denture stability and retention. (Wong et al., 1999)

Concerning water absorption, some studies demonstrated that the greatest dimensional changes was occurred during the first month and no

remarkable changes took place after two months (Pow et al., 1998). Due to PMMA denture base should be influenced by water absorption, some authors insisted that occlusal adjustment of denture would be delayed until PMMA has become saturated with water. However, Some authors researched about changes in dentures during storage in water and in service for 18 months, and concluded a posterior linear expansion of heat curing resin was less than 1.0% and the dimensional changes did not affected the fit of denture, and other studies also reported that there was no significant volumetric deformation in denture when denture was being stored in water (Yeung et al., 1995).

Most of previous studies tried to measure deformation and accuracy of the denture 2-dimensionally. Nowadays, some authors tried to investigate the dimensional stability, and it is possible to compare two objects three-dimensionally by using surface matching program and scanning device. (Rafael Leonardo Xediek 2006, Consani et al., 2002)

The studies done in the past years indicate that the acrylic denture base resins tend to absorb water, in this manner expansion can make up when minimal polymerization shrinkage takes place. This can clarify the minimal measure of dimensional changes seen in acrylic heat cure denture resins which were put in water which is as per the findings of this study. Wong et al, revealed that the tendency to retain water in acrylic resins show shrinkage amid setting. Expansion that follows absorption of water can make up for a part or the majority of the polymerization shrinkage or even expansion can happen. (Wong et al., 1999)



Consani reported that 90 days of storage of denture bases in water did not result in significant changes in distances between the teeth in comparison to deflasking period (Rafael Leonardo X. Consani et al., 2010). Goodkind conducted a study which indicated that water immersion had no critical impact on denture base measurements (Goodkind & Schulte, 1970). Miessi [24] reported that 180 days of immersion in water caused major dimensional changes and adaptation problems in denture bases. Some authors have reported that water storage of acrylic denture bases results in expansion due to water sorption. (Miessi et al., 2008) Water sorption forces the macromolecules apart and results in acrylic expansion. This expansion compensates the polymerization shrinkage of acrylic resin and improves the adaptation of denture bases with underlying tissues (Goiato et al., 2013). The present study also confirmed this finding and showed that in both experimental groups, 30 days of storage in water resulted in a significant decrease in dimensional changes and compensated the polymerization shrinkage.

## CONCLUSION

Within the limitations of this study, water and artificial saliva were the best mediums to be used as a storage medium.

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