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The effect of storage and curing time on dimensional changesof visible light cured acrylic denture base (VLCADB)

[1]MuntherKazanji, [2]AbdullqadirMajeed and [3]ShukriaHussien
[1,2,3]*School of Dentistry, Faculty of Medical Sciences, University of Duhok,1006AJ DuhokCity, Kurdistan region - Iraq*

Abstract: *An accurate and stable record bases is needed for recording Maxillio-Mandibular relationship during the construction of a complete denture, toensure this accuracy the record bases should maintain close adaptation to the cast and to be dimensionallystable. Therefore, this study aimed to evaluate the changes of thickness and deformation of visible light cure acrylic denture base (VLCADB)after curing time of two and four minutesand after storage time of two and seven days in water at 23 ± 2 ºC. For this purpose 60 specimens of the material were prepared and divided in two groups of 30 each, then each group was divided into three groups of 10 for each (10 specimens control, 10 specimens with two days of storage and 10 specimens with seven days of storage).*

Measurements of thickness and deformation were recorded pre and post curing of specimens and after storage for for two and seven days in water. The results revealed significant differences in thickness after curing the specimens for twoand fourminutes. Furthermore, storage for twoand sevendays in water showed also significant differences. Also, a significant deformation changes were recorded after curing twominutes and after storage two and seven days.

Keywords: *VLCADB, dimensional changes, thickness changes, curing methods, relining*

I. Introduction

Visible light cure acrylic denture base (VLCADB) are the materials of choice for a wide range of clinical applications such as repair material, special tray, record base,patients who are hypersensitive to poly methyl methacrylate,for relining and for obturators. These materials exhibit superior handling characteristics when compared to chemically cured materials [(1-4)].

VLCADB consist of urethane dimethacrylate matrices with an acrylic co polymer, microphone silica fillers and a photo initiator. These materials are polymerized in a light chamber with blue light (wave length of 400 - 500 nm) [(5)]. This visible light covert the material from viscous paste to plastic state[(6)].The polymerization of the material may be affected by various factors such as composition, quality of light, curing time, exposure time and also by material thickness [(7)].The thickness of the material is believed to be an important factor in determining the magnitude of shrinkage that occurred during curing [(8-9)].

During the curing process, the dimensional changes have great effect on the stability and retention of the record bases [(10-11)].Cosami et al, 2002 suggested that the molar region is most reliable site for gap space production between the palatal zone and the record base due to linear shrinkage and deformation of the acrylic[(12)]. The magnitude of this change however, may influenced by several factors such as polarization technique, when an internal stresses are produced by a different coefficient of thermal expansions of gypsum and acrylic resin and due to different thicknesses of base used [(13-14)].Fatihallah et al, 2009 evaluated the dimension stability of denture bases and in different curing techniques, the results showed that the heat and cold cured acrylic resins are more stable than visible light cure acrylic denture base[(15)].

The aim of this study is to evaluate the changes of thickness of the VLCADB after curing for two and four minutes. The effect of storage in water for two and seven days was also examined.

II. Material and methods

60 specimens of VLCADB (plaque - photo - Germany) brand were prepared having the dimensions 50×25mm (length & width receptively). 30 specimens were employed for each curing time used in the present study namely,two and four minutes.For each curing time, the 30 specimens were divided into threegroups of 10 specimens for each and for different storage time (control - after curing, after two days and sevendays storage). All specimens were stored in water at room temperature (23 ± 2 ºC).The specimens were prepared by cutting the visible light cure sheets on a glass slab to the dimension mentioned before using cover slide of the same dimension and surgical knife.

For accurate measurements of thickness, the specimen was invested by sandwiching them between twocover slides to avoid distortion of the material during the measurement and by using the Vernier at 0.01 mm accuracy. The measurements were recorded from right and left side of the specimen beside the average of these

measurements. This was done before curing the specimen and considered as the initial thickness.After that the each specimen was polymerized for twoor fourminutes according to the group by light curing machine (light curing unit/HLSnail - 36 dental product / GmbH Germany) following the manufacturers interactions. After curing, the specimens were removed from curing unit and the thicknesses were measured. The difference between this reading and the initial reading was assumed to represent dimensional change in thickness after curing.These measurements were done after storage of specimens for two and sevendays in water.

For measuring the deformation that accused after curing (curvature changes) the specimen with the twocover slides placed between the two peaks of the caliper and the changes in curvature with the flat surface of the glass slide and in the middle of the specimen was recorded. The data obtained in this study were statically analyzed by deceptive statistics and analysis of variance (ANOVA).

III. Results and discussion

The mean values and the standard deviation of the result of changes in thickness and deformation percentageare listed intables 1 and 2.

Table 1. Changes in thickness and deformation percentages (two minuters curing)

Thickness (mm)				Deformation (%)		
Control	After 2min	After 2days	After 7days	Control 2min	After 2days	After 7days
2.72	2.90	3.13	3.13	0.08	0.08	0.10
2.70	2.97	3.11	3.10	0.14	0.14	0.12
2.67	2.96	3.00	3.05	0.12	0.12	0.10
2.81	2.80	2.90	2.90	0.16	0.16	0.90
2.60	2.80	2.90	3.10	0.08	0.16	0.16
2.55	2.87	2.89	2.80	0.16	0.08	0.10
2.66	2.93	2.96	3.12	0.16	0.16	0.11
2.77	2.80	2.75	3.05	0.12	0.12	0.10
2.81	2.85	3.05	3.05	0.08	0.08	0.60
2.77	3.04	3.05	3.25	0.12	0.12	0.14

Table 1.Changes in thickness and deformation percentage (four minutes of curing)

Thickness (mm)				Deformation (%)		
Control	After 2min	After 2days	After 7days	Control 2min	After 2days	After 7days
2.70	2.90	3.27	3.14	0.08	0.15	0.12
2.70	3.05	3.08	3.00	0.17	0.16	0.17
2.80	3.20	3.12	3.00	0.14	0.16	0.14
2.70	3.05	3.95	2.90	0.17	0.07	0.08
2.68	2.80	3.09	3.05	0.05	0.12	0.10
2.75	3.20	2.58	3.08	0.17	0.10	0.15
2.60	3.00	3.15	3.07	0.12	0.17	0.20
2.60	3.20	3.25	3.25	0.22	0.24	0.18
2.62	3.10	3.25	3.25	0.20	0.18	0.18
2.70	3.10	3.05	3.05	0.20	0.18	0.18

The results of the effect of curing time twoandfour minutes on dimensional changes revealed a processing shrinkage of the specimen with increases in thickness ofthe material, in addition to that the deformation that occurred in the specimen considered a short coming of this material to be used clinically for relining. These dimensional changes that occurred after processing have been recognized by several investigators [17 - 21].
In order to compare the changes in the thickness among the tested groups (pre- and post- curing of two and four minutes, and after storage on day and seven days), analysis of variance was performed and the results were summarized in tables 3 and 4.

Table 2. Summary of results after two minutes of curing

Groups	Mean	SD	P-value
Control thickness (mm)	2.706	0.087	--------
After2min thickness (mm)	2.892	0.082	0.001
After2days thickness (mm)	2.974	0.117	0.000
After7days thickness (mm)	3.055	0.125	0.000
Deformation control 2min	0.122	0.033	--------
Deformation 2days	0.122	0.033	1.000
Deformation 7days	0.243	0.277	0.000

Table 3. Summary of results after four minutes of curing

Groups	Mean	SD	P-value
Control thickness (mm)	2.685	0.064	-------
After2min thickness (mm)	3.060	0.132	0.000
After2days thickness (mm)	3.179	0.335	0.002
After7days thickness (mm)	3.079	0.109	0.000
Deformation control 2min	0.152	0.054	-------
Deformation 2days	0.153	0.047	0.957
Deformation 7days	0.150	0.039	0.900

The results showed a significant differences (P-value) in mean thickness between pre-and post- curing of specimens fortwo and fourminutes (P<0.001).The results of the deformation of specimens showed also a significant differences of specimens after curing for two minutes but no significant differences were found after curing for four minutes for the two storage intervals (two and seven days) as the results shown in tables 3 and 4.

The most possible explanation for the obtained results in present study is that during polymerization and conversion from viscus state to a plastic state of the material, a strain release and this strain may possibly concentrated in the middle part do the specimen which leads to this deformation which was detected in this study.These results come in agreement with Faithallah et al, 2009 in which the visible light cute materials showed the greater gap between the palate and the cast in comparison with heat cured and cold cured acrylic resin[(15)].

These results also indicate that dimensional accuracy is an inevitable short coming of VLCADB and one of the factors that may contribute to the gap that exist between the palatal part of the denture base and the palatal tissue [(8, 16 - 20)].In clinical situation and due to the shape of palatal concavity, shrinkage occurs towards the residual ridge leads to the lifting of the record base in the mid palatal region which was cited by Won-Suck Oh and Kenneth,2008 [(21)].

Inconclusion,although these materials exhibit dimensional instability could be used for trail record bases or special stray,however the changes in thickness and the deformation that formed after curing,makes the material notsuitable for relining dentures. Furthermore, curing and storing of specimens lead to deformation and increase in thickness and this will make the material unsuitable as perminantbases and for relining dentures.

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