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Evaluation of Dimensional Stability for Denture Bases in different Curing Techniques

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Abstract:

Stable record base is critical for recording an accurate maxillo-mandibular relationship and evaluation of the esthetics and phonetics of the wax trial prosthesis. To ensure intra-oral stability and retention of the record base, the base should maintain close adaptation to the cast and be dimensionally stable, this study compare the dimensional stability of visible light cure acrylic both conventionally and by using new technique of short curing cycle. Thirty maxillary cast edentulous models poured with a type IV dental di-stone, the specimen divided into three subgroups each group consist of ten cast. In the first group denture base constructed from heat cure acrylic resin using short curing cycle, while in the second group it constructed by using visible light cure acrylic resin and for the third group from visible light cure acrylic resin using new technique, the gap space occurs between the denture base and the cast measured by using traveling microscope measuring device. In this study the reading for the gap space occur between the denture base and the cast show that significantly both the short cycle and VLC new technique more dimensionally stable than that of VLC conventional technique when compared by ANOVA Table and LSD multiple comparison. The dimensional accuracy or fit for the denture base improved by using either a heat cured acrylic resin (using short curing cycle or by using light activated poly methylmethacrylate with the aid of new technique so that better stability and retention of the record bases obtained.

Keywords: Dimensional changes , gap space, visible light cure acrylic resin, short cycle.

Introduction

Acrylic resins were introduced to dentistry in 1937, till now no other material has been found that matches the appearance of the oral soft tissues with as great as fidelity as acrylic resin, its overall performance is regarded as satisfactory and it is widely used for the construction of complete dentures.

Certain lack of dimensional stability must be accepted as one of the disadvantages of acrylic resin dentures. At least two recognized dimensional changes are unavoidable in every acrylic resin denture, namely shrinkage and expansion.

Dimensional changes that occur in acrylic resin dentures are influenced by the curing method and other factors

.the thickness of acrylic resin dentures is believed to be a significant factor in determining the magnitude of shrinkage that occurs during curing .[1,4]

In denture base the dimensional changes result from both polymerization shrinkage and stresses released during flask cooling. Conversely, the variations in curing technique may not significantly alter the pattern of dimensional acrylic resin behavior due to the decrease in the molecular weight of the resulting polymer chains.

During curing and processing of the denture base the dimensional changes may affect the satisfaction of the patient and stability and retention of record bases subsequently evaluation of the other steps of denture construction.[5,6]

Consani et al suggested that the molar region is the most reliable site for gap space production between the palatal zone and the record base due to linear shrinkage.[7,9]

The magnitude of the acrylic resin dimensional changes, however, may be influenced by several factors, such as polymerization techniques, where the internal stresses are produced by different coefficients of thermal expansion of gypsum and acrylic resin and the base thickness may vary at different sites inside the flask altering the denture base adaptation and stability.[10,11]

Little experimental work had been reported about the use of visible light activated resins for denture the report deals primarily with the physical and mechanical properties of denture bases

The purpose of this study was to compare the dimensional stability between VLC acrylic resin (conventional and new technique) and the ordinary heat cure acrylic resin.

Materials and Methods

Thirty maxillary edentulous cast models were poured with type (IV) dental stone (Zeus-Bluejey-Gesso ExtrduroIV –permodel I), divided into three main groups each group consists from ten casts.

1-The first denture base group was constructed from heat activated polymethyl methacrylate (Pyrax ISO 9001:2000 certified company).

2-Mixing of heat activated poly methyl methacrylate done according to the manufacturers instructions follow the ratio of 3:1. The dough stage was closely adapted to the model cast and then flasked under pressure of 10 Ibs for 5 min. A short curing cycle used.

3-The temperature brought to 74 °C for 90 minutes, the temperature, was raised to 100 °C for additional 30 minutes.

The second group of ten denture bases was processed by the following technique:-

1. Using visible light cure material (palatray XL-Heraeus Kulzer GmbH and Co. KG).
2. The VLC sheet was closely adapted to the model cast (socked finger with water) pressure starting from the centre toward the periphery to reduce air bubbles beneath the VLC sheet and then placed inside the polymerizing device (YETI dental – Preci NT shuttle II-Preci NT Shuttle IV), for (4 min.).

The third denture base group which consist of 10 casts were constructed according to the following steps:-

1. The VLC sheet was adapted carefully by hand using gentle (socked finger with water) pressure starting from the center of the cast towards periphery to reduce air bubbles beneath the VLC sheet. The access materials were trimmed from the borders.
2. U shape segment of the adapted VLC sheet along the residual ridge was cut and placed away, the remaining VLC

sheet on the cast was placed in the polymerizing unit for (4 min.) then the cast was removed the cut U shape segment was replaced again on the cast then the cast was placed in the polymerizing unit for additional (4 min.) to reduce air bubbles beneath the cut U shape segment. The whole VLC denture base was polymerized under visible light wave (475 µm) and light intensity (90 µm/cm^2).

3. The record base assembly was removed from the cast model and finished by using carbide bur (biggo-Germany) and cleaned with water and soap to remove the residual access material figure (1).

The measurements were done by traveling microscope which is capable of measuring up to 0.001 of mm, after that the base of the casts transversely sectioned into three parts, as follows: Canine part, molar part and posterior palatal seal part. In this study, the molar part selected and the mesial aspect of it taken to measure the dimensional stability by marking a three points the 1st one on the right ridge crest, 2nd one on the mid-palatal and the 3rd on the left ridge crest figure (2).

Analysis of the variances done by ANOVA Table with LSD.

Results

At both ridge crests and mid-palatal region a higher values of gap space occurs in case of VLC conventional technique when compared with both short cycle curing and VLC new technique Table (1) and figure (3), so that there was a significance difference between the visible light cure (VLC) new technique and both short cycle curing and conventional technique of VLC Table (2).

ANOVA Table LSD multiple comparison for dimensional change occur between the three techniques in the three region shows that high significant difference between both short cycle curing and VLC new technique with that of conventional technique of VLC at the ridge crest and mid-palatal regions .on the other hand nearly no significant difference shown between short cycle curing and VLC new technique as shown in Table (2).

Discussion

The processing shrinkage of denture base acrylic resin is accepted as shortcoming of this material, a space beneath the posterior palatal region resulting from processing shrinkage, this dimensional change that occurs during the denture processing was recognized by several studies previously and the most possible explanation is that the strain release in maxillary denture base tends to draw the flange inward and the resulting premature contact (gap) of the denture base with the mold in these regions causes the palate to be elevated, , these results also indicate that dimensional accuracy is an inevitable shortcoming of acrylic resin and one of the factors that may contribute to the denture gap discrepancy.[1,12, 14-18].

This study showed dimensional accuracy or fit of the denture base processed by short curing cycle of heat cured acrylic resin and VLC new technique are better than VLC conventional technique in reducing the gap at the posterior palatal seal area according to Table (1, 2), which agreed with findings of Won-suck et al.[13]

The edentulous maxilla consists of a relatively flat portion in the middle of hard palate and inclined slops towards the residual ridge. Due to the shape of palatal concavity, shrinkage occurs toward the residual ridge leads to lifting of the record base in mid-palatal region which was cited Won-suck et al[13]. By dividing the VLC sheet into

two pieces along the junction of horizontal and vertical configuration of the palate the stresses that develop during polymerization can be confined within each segment of the material and lead to shifting the direction of shrinkage from the ridge crest area to two separate areas in the middle of the palate and the crest of the ridge.

This study came into agreement with Kenneth et al [19] as by limiting the amount of composite exposed to the curing light at one time, and readapting the uncured composite to the cast between curing episodes, gap formation caused by polymerization distortion can be minimized.

It is theorized that a record base with a dimensional change of that proportion resting on compressible tissue would be compensated without compromising stability. [19]

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Table (1): Mean gap space analysis for the three techniques at the three regions.

Region	No.	Short cycle		No.	Visible light polymerization conventional technique		No.	Visible light polymerization new technique	
		Mean	SD		Mean	SD		Mean	SD
Right ridge crest	10	0.16	0.041	10	0.23	0.120	10	0.16	0.041
Mid-palate	10	0.24	0.094	10	0.56	0.143	10	0.13	0.057
Left ridge crest	10	0.016	0.008	10	0.084	0.027	10	0.014	0.00

Table (2): LSD comparison between the three techniques in the three regions.

Region	Short cycle	VLC conventional technique	VLC new technique
Right Ridge crest	S.	S. N.S.	
Mid-palate	V.H.S.	V.H.S. S.	
Left Ridge crest	V.H.S.	V.H.S. N.S.	

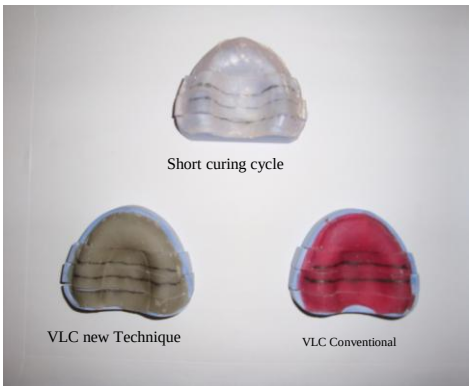

Figure (1): The three groups sectioning

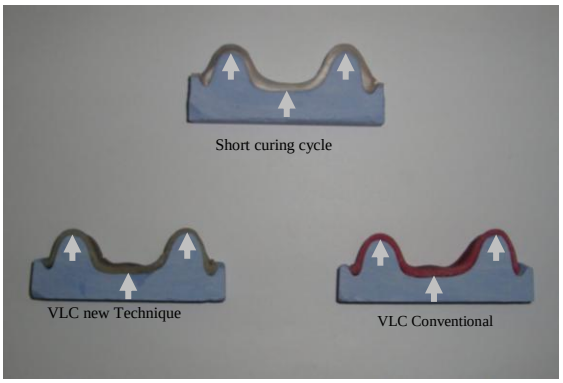

Figure (2): Points selected on the transverse section for the three groups

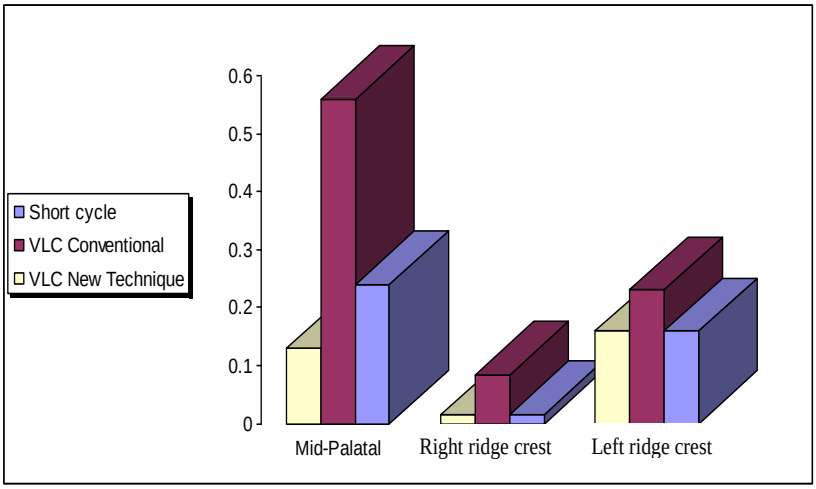

Figure (3): Represents Histogram for the groups mean values