Acta Scientific Dental Sciences
Volume 2 Issue 5 May 2018
Research Article

Dimensional Changes and Water Sorption of Vertex Thermosense Versus a Conventional Heat Cured Denture Base Materials

Saleh Abdullah Al-Ghamdi[1], Omar Abdullah Alsfri[2] and Ibrahim Mohamed Hamouda[1,3]*

[1]Restorative Dentistry Department, Faculty of Dentistry, Umm Al-Qura University, KSA

[2]Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Umm Al-Qura University, KSA

3Dental Biomaterials Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt

***Corresponding Author:** Ibrahim Mohamed Hamouda, Professor of Dental Biomaterials, Dental Biomaterials Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt and Professor of Dental Biomaterials, Restorative Dentistry Department, Faculty of Dentistry, Umm Al-Qura University, KSA.

Received: December 16, 2018; **Published:** April 24, 2018

Abstract

Objectives: This study aimed to compare the dimensional changes and water sorption of Vertex Thermosense and the conventional heat-cured denture base materials.

Materials and Methods: Two types of dentures base materials were used (Vertex Thermosense and Major.base.20). Twenty wax specimens were prepared from both materials of 65 mm long, 10 mm wide, and 3 mm thick. The wax specimens were flasked and processed according to the ANSI/ADA specification No. 12 for denture base polymer and according to the manufacturer's instructions. The dimensional changes were measured immediately after deflasking, one day, two days and three days of water storage. The dimensional changes were measured using micrometer. For water sorption, twenty disk specimens of 50 ± 1 mm in diameter and 0.5 ± 0.05 mm thick were prepared. Water sorption was measured using an electronic balance.

Results: The results of this study showed that, Vertex Thermosense denture base material exhibited higher dimensional changes and water sorption than that of the conventional material (Major.base.20).

Conclusion: ThermoSense showed significant shrinkage all over the tested periods. On the other hand, Major.base.20 denture base material showed significant expansion to compensate the curing shrinkage after 3 days of water storage. Vertex ThermoSense showed significantly higher water sorption than that of Major.base.20. Both materials exhibited increasing amount of water sorption up to 3 days.

Keywords: Vertex Thermosense; Denture Base Material; Conventional Acrylic Resin; Dimensional Changes; Water Sorption

Introduction

The major objective for complete denture construction is to obtain a denture base that conforms the supporting tissues to a high degree of accuracy. These properties of the denture bases are generally more important to the performance of the dentures and its retention [1]. A variety of materials have been used in the fabrication of denture bases. The most acceptable denture base material available was the methyl methacrylate resins which more esthetic alternatives to the previous rubber materials. Unfortunately, all available resins used in dentistry undergo shrinkage during processing. Ill fit denture was apparent because of denture base shrinkage [2].

The great majority of dentures are fabricated from rubber-reinforced poly(methyl methacrylate) and heat-cured poly(methyl methacrylate). Dentures fractures still occur, but are usually related to unreasonable or carelessness use by the patient. Recent advances and modifications of poly-methyl methacrylate had been used for denture base applications, include pour type denture resins, hydrophilic polyacrylates, high impact strength resins, rapid heat polymerized acrylic, and light activated denture base material [3].

Vertex™ ThermoSense is the innovative, virtually unbreakable, new monomer-free rigid denture base material from Vertex-Dental B.V. The company offers many advantages for its product such as low allergy risk, no volume shrinkage, possibility to repairs, rebasing and relining, available in 15 colours, easy and quick to polish, good humidity resistance [4].

The greatest amount of processing shrinkage occurs on the posterior border of the denture base. An increasing in the curvature of the tissue at the posterior palatal region, the greater its distortion. Many studies shown non-uniform discrepancy between the denture base and cast. Discrepancies in this region will most certainly have undesirable effect on the retention of a denture base [5].

Gradual expansion of the acrylic dentures results after storage in water. It is thought that this expansion would partly compensate the processing shrinkage after period of time. Denture plastics of the same type may vary considerably in water sorption because of the presence of additives [3]. So, this study was aimed to compare the dimensional changes and water sorption of Vertex Thermosense and the conventional heat-cured denture base materials.

Materials and Methods

Dimensional changes testing

Twenty specimens were prepared from both Vertex Thermosense (Vertex Dental B.V. 3705 HJ Zeist, Netherlands) and Major. base.20 (Major Prodotti Dentari S.p.A; Italy) denture base materials. A stainless-steel mold of 65 mm long, 10 mm wide, and 3 mm thick was fabricated. Impression was made for the stainless-steel mold with the use of a polysiloxane impression material (Silastic E; Dow Corning, Midland, Mich, USA). 20 wax blocks were prepared (True Wax, Dentsply International Inc., York, Pa.). The wax blocks were flasked in dental flasks. The wax specimens were washed-out using boiling water for 10 minutes. Sodium alginate separating medium was applied to the exposed dental stone and prepared mold.

Specimens were prepared from both denture base materials according to the manufacturer's instructions. For the conventional heat-cured acrylic resin (Major.base.20), the correct P/L ratio (3:1) was mixed in a glass container. The resin dough was pressed for 10 minutes at a pressure 1000 kpa (10 bars). Then the resin was processed by the long curing time at 74ºC for 8 hours followed by boiling for an addition alone hour. The denture flask was cooled slowly to room temperature, the specimens were deflasked and slightly finished under water cooling system.

On other hand, for Vertex ThermoSens, preheated cartridge for16 minutes at 280 degrees at a pressure 6.5 bars. The Vertex Thermosens cartridge sprayed with silicone in the chamber. Then the process was completed on the machine specially for vertex called thermos-injector to prepare 10 specimens. All specimens were separated from the denture flask and slightly finished for excesses. The specimens were measured immediately after deflasking using micrometer. Measurements were repeated after 1, 2, 3 during storage in distilled water at room at 37ºC.

Water sorption test

Twenty samples were prepared according to the ANSI/ADA specification No. 12 for denture base polymer and according to the manufacturer's instructions. The disk specimen of 50 ± 1 mm in diameter and 0.5 ± 0.05 mm thick was formed in a stainless steel using gypsum mold. The disks were dried in a desiccator containing thoroughly dry anhydrous calcium sulfate at 37ºC for 24 hours, removed to a similar desiccator at room temperature for one hour, then weighed using an electronic balance (Sartorius MCI Research RC Z10 D, Sartorious AG, Gottingen, Germany). This cycle was repeated until a constant weight was attained (WI). The disks were immersed in deionized distilled water at 37ºC for 7days, after which time the disks were removed from the water with tweezers, wiped with clean, dry hand towel until free from visible moisture, waved in air for 15 seconds, and reweighed one minute after removal from the water (W2). Water sorption was calculated by the following formula:

$$\text{Water sorption (mg/cm2)} = \frac{\text{W2(mg) -W1(mg)}}{\textit{surface}\text{ area (cm}^2\text{)}}$$

The data were collected and statistically analyzed.

Statistical analysis

Statistical analysis of the results was carried out with one-way ANOVA and LSD-test to compare the mean values of two types of denture base materials.

Results

The mean dimensional changes of the Vertex ThermoSense versus a conventional heat cured (Major.base.20) denture base material by time changes were presented in table 1. The statistical analysis of the results showed a significant difference between the dimensional changes of Vertex ThermoSense and that of Major.base.20 immediately after deflasking, after 1 day and 3 days of storage in water ($P < 0.01$). There was no significant difference between the dimensional changes of Vertex ThermoSense and Major.base.20 after 2 days of water storage ($P \geq 0.05$). Vertex ThermoSense showed significant shrinkage all over the tested periods. On the other hand, Major.base.20 denture base material showed significant expansion to compensate the curing shrinkage after 3 days of water storage.

Materials	Immediately	1 day	2 day	3 day	F-value	P-value
Vertex- ThermoSense	63.84 ± 0.036^{A}	63.5 ± 0.034^{D}	63.63 ± 0.035^{B}	63.79 ± 0.035^{A}	46.4	P ≤ 0.01*
Major.base.20	63.51 ± 0.034^{D}	63.57 ± 0.034^{C}	63.6 ± 0.035^{B}	63.6 ± 0.035^{B}		

Table 1: Mean and standard deviations of dimensional changes of Vertex ThermoSense versus Major.base.20 denture base materials at different time intervals.

Means of different superscripted letters are significantly different

* Highly significant difference

The mean water sorption of Vertex ThermoSense versus a conventional heat cured (Major.base.20) denture base materials by time changes were presented in table 2. The statistical analysis of the results showed a significant difference in water sorption between the Vertex ThermoSense and that of Major.base 20 all over the tested times. Vertex ThermoSense showed significantly higher water sorption than that of Major.base.20 (P< 0.001). Both materials exhibited increasing amount of water sorption up to 3 days.

Materials	1 day	2 day	3 day	F-value	P-value
Vertex-Thermo-Sense	0.0670 ± 0.024^{C}	0.0715 ± 0.016^{B}	0.0761 ± 0.025^{A}	7	P ≤ 0.001*
Major. base.20	0.0609 ± 0.014^{E}	0.0650 ± 0.015^{D}	0.0706 ± 0.024^{B}		

Table 2: Means and standard deviations of water sorption of Vertex ThermoSense versus the conventional heat cured denture base materials at different time intervals.

Means of different superscripted letters are significantly different

*Very highly significant difference

Discussion

All available resins used in dentistry undergo shrinkage during processing. Ill fit denture was evident because of shrinkage of denture base [6]. It was evident that the commercial products highly influenced the dimensional stability of the acrylic resin bases [7].

The dimensional changes of the denture base result from both polymerization shrinkage and stresses released during flask cooling [7,8]. 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 [9], and the base thickness may vary at different sites inside the flask [10,11], altering the denture base adaptation and stability [12].

Long curing cycle was selected for processing the conventional denture base material because it a satisfactory curing method, as it showed the least amount of denture base warpage [3], thus they could be used as a reference for comparison with Vertex ThermoSense. ThermoSense was processed according to the manufacturer's recommendation to assure the best level of dimensional accuracy as stated by the manufacturer. Slow cooling of the flask was performed to avoid excessive warpage of the denture that results from stress releasing.

The denture bases were tested for accuracy immediately after decasting since the distortion upon removal of the denture from the cast was greater than any other subsequent changes, due to strain relaxation [13,14].

The dimensional distortion occurs during cooling or after the base is separated from the cast [15]. Gradual expansion of the acrylic dentures results after storage in water. It is thought that this expansion would partly compensate the processing shrinkage after period of time demonstrated that no significant dimensional change for 1-week immersion in water for dentures produced by trial technique and for storage in water up to 30 days [14-16]. Denture plastics of the same type may vary considerably in water sorption because of the presence of additives [3].

There was an attempt to add an additional evaluation of denture bases accuracy after immersion in water, for the reported enhancement of denture base accuracy due to water sorption [14-16]. The denture bases were stored in water at room temperature for 4 weeks; as the major portion of the expansion in water takes place during the first month, and the changes are insignificant after 2 months [3].

The results of this study revealed that, Vertex ThermoSense showed significant shrinkage all over the tested periods. The amount of shrinkage could not be compensated in Vertex ThermoSense although it was stored in water for 3 days. Major.base.20 denture base material showed significant expansion to compensate the curing shrinkage after 3 days of water storage.

Conclusions

The results of this study concluded that: Vertex ThermoSense showed a significant shrinkage all over the tested periods. On the other hand, Major.base.20 denture base material showed significant expansion to compensate the curing shrinkage after 3 days of water storage. Vertex ThermoSense showed significantly higher water sorption than that of Major.base.20. Both materials exhibited increasing amount of water sorption up to 3 days.

Conflict of Interest

The authors declare that there are no any financial interest or any conflict of interest exists.

Bibliography

1. Chandu GS., *et al*. "A comparative study of retention of complete denture base with different types of posterior palatal seals – an in vivo study". *Clinical, Cosmetic and Investigational Dentistry* 6 (2014): 95-100.
2. Dixon DL., *et al*. "Linear dimensional variability of three denture base resins after processing and in water storage". *Journal of Prosthetic Dentistry* 68.1 (1992): 196-200.
3. Craig RG. "Craig's Restorative dental materials, 12th edition". Mosby Elsevier, St. Louis, Missouri (2006): 23-532.
4. Vertex-dental.
5. Vivek VN., *et al*. "A comparative study of different laboratory techniques to control posterior palatal shrinkage in maxillary complete dentures". *Health Sciences* 2.3 (2013): 1-14.
6. Thompson VP., *et al*. "Dental resins with reduced shrinkage during hardening". *Journal of American Dental Association* 58.5 (1979): 1522-1532.
7. Consani RLX., *et al*. "Effect of Commercial Acrylic Resins on Dimensional Accuracy of the Maxillary Denture Base". *Brazilian Dental Journal* 13.1 (2002): 57-60.
8. Anusavice KJ. "Phillips' science of dental materials, 11th edition". W.B. Saunder Co., Philadelphia (2003): 54-742.
9. Woelfel JB., *et al*. "Some physical properties of organic denture base materials". *Journal of American Dental Association* 67.4 (1963): 489-504.
10. Wolfaardt JF., *et al*. "The influence of processing variables on dimensional changes of heat-cured polymethyl methacrylate". *Journal of Prosthetic Dentistry* 55.4(1986): 518-525.
11. Chen JC., *et al*. "Effect of denture thickness and curing cycle on the dimensional stability of acrylic resin denture bases". *Dental Material* 4.1 (1988): 20-24.
12. Jackson AD., *et al*. "Dimensional accuracy of two denture base processing methods". *International Journal Prosthodontics* 2.5 (1989): 421-428.
13. Phillips RW. "Skinner's science of dental materials, 8th edition". W.B. Saunder Co., Philadelphia (1982): 177-204.
14. McCartney JW. "Flange adaptation discrepancy, palatal base distortion, and induced malocclusion caused by processing acrylic resin maxillary complete dentures". *Journal of Prosthetic Dentistry* 52.4 (1984): 545-553.
15. Heqde V., *et al*. "Comparative evaluation of the effect of palatal vault configuration on dimensional changes in complete denture during processing as well as after water immersion". *Indian Journal Dental Research* 15.2 (2004): 62-65.
16. Winkler S. "Essentials of complete denture Prosthodontics, 2nd edition". PSG Publishing Co., Inc. Littleton, Massachusettes (1988): 71-315.

Volume 2 Issue 5 May 2018