Original Articles

Linear Dimensional Changes of Acrylic Resin Denture Bases After Using Denture Cleansers: Conventional and Injection-molding Techniques

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Abstract

The purposes of this study were to compare the linear dimensional change of specimens processed by the conventional compression and injection techniques before and after immersion in denture cleansers to simulate 180 days of use. There were two groups of material; heat and IvoBase hybrid. Each material was divided into four groups; before immersion, immersion in tap water, Polident, and 5% vinegar diluted with tap water 1:6 (n=8). The linear dimensional change was measured using a stereo microscope machine. The independent sample *t*-test demonstrated that the linear dimensional change of the IvoBase hybrid with injection technique was significantly lower than that of the heat-polymerized acrylic resin with compression technique. Nevertheless, the result of one way ANOVA illustrated insignificant differences in the linear dimensional change after denture cleansers immersion. It can be concluded that the IvoBase hybrid with injection molding technique had a lower linear dimensional change than that of the heat-polymerized with conventional compression technique regardless of denture cleanser immersion. Diluted vinegar is an alternative product that can be used as a long-term routine denture cleanser agent like Polident.

Keywords: Acrylic resin, Denture cleansers, Linear dimensional change

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Introduction

Polymethyl methacrylate (PMMA) is the most common denture base material owing to its many advantages, including superior esthetic, adequate strength, low water sorption, low solubility, lack of toxicity, and ease to repair and construction.[1] For denture fabrication, compression molding with heat curing in a water bath is the widely used conventional method. However, there are inaccuracies of a denture base material including dimensional change and shrinkage during processing. These adverse effects associated with the compression molding technique affect the movement of the artificial teeth position and enlarge the space between the denture base and underlying

mucosa. It can lead to occlusal problems and compromising dentures fit.[2,3]

Therefore, composition and processing methods of acrylic resin have been developed to enhance the physical and chemical properties of denture bases. In 1942, Pryor introduced the injection molding technique to overcome the adverse effects of compression molding method.[4,5] Continuous injection molding technique can get rid of the resin flash between the upper and lower flasks and permits control of the direction of the polymerization process by changing the flask design.[6,7] Moreover, the polymerization shrinkage is compensated by the continual flow of material from the feeding sprue.[8]

Recently, a new injection machine (IvoBase Injector, Ivoclar Vivadent, Schaan, Liechtenstein) has been launched. This machine is "all-in-one" which allows full automation including controlled injection and polymerization process. newly improved polymethyl methacrylate (IvoBase hybrid) coordinated with the system.[9,10]

Regardless of the material and construction method of the removable prosthesis, all denture wearers are advised to maintain good oral and denture hygiene. Nevertheless, they are chiefly older people who have limited ability to clean dentures. The previous study revealed that most denture patients have poor oral hygiene, poor denture cleanliness, and wear dentures at night. It can produce denture-related stomatitis.[11]

In order to prevent denture stomatitis, maintaining oral health with an appropriate denture cleaning routine is essential. The most effective procedure to eliminate biofilm are mechanical methods. However, chemical denture cleansers are also efficient in reducing biofilm formation, including *Candida albicans.*[12] Unfortunately, the use of a denture cleansing tablet is troublesome because of its high cost, its limited market access, and its insufficient instruction and information provided to the patients.[13]

Vinegar is an alternative denture cleansing agent. It consists of 5-20% of acetic acid, water, and other substances. Its good points are it is cheap, easily available, and has antimicrobial potential. *In vitro* experiments have already shown that acetic acid induces programmed cell death in *Candida albicans.*[14,15]

Daily use of denture cleansers can degrade denture base materials if not used following the manufacturers' instructions. Many studies have been done to evaluate the effect of commercial denture cleansers on the physical properties of acrylic resin.[16,17] However, previous studies have not evaluated the effect of vinegar on linear dimensional change of denture base acrylic resin.

Therefore, the objectives of this study were to compare the linear dimensional change between heat-polymerized acrylic resin and the IvoBase hybrid and to investigate the effect of soaking in denture cleansers for 180 days.

Materials and methods

1. Specimen fabrication

Rectangular metal molds were fabricated with an inside space 24 mm in length, 16 mm in width, and 3 mm in thickness; with a rectangular groove of a depth of 0.4 mm at the floor of the mold (Fig. 1A). There were two channels on both sides for the injection molding technique (Fig. 1B). The center of the mold had two screw holes that penetrate through the floor of the mold. Thereby, a screwdriver can turn the screws from under the mold to push the specimen out (Fig. 1A). The mold was covered by a metal lid during the processing procedure (Fig. 1B).

Rectangular metal molds were invested into the lower half flasks in both the conventional compression and the injection molding techniques (Fig. 1C, 1E). Then, the metal lids were closed off on metal molds before the upper half flasks were proceeded (Fig. 1D, 1F).

For the heat-polymerized acrylic resins (Meliodent®, Hareaus Kulzer Ltd., Berkshire, UK), it was mixed according to the manufacturer's instructions. At the dough stage, it was placed into the lower half flask. Then, the upper half flask was pressed slowly in a manual dental laboratory press. The flask was opened and the excess resin flash was cut off twice. The flask was closed and pressed in the

dental laboratory press for one hour. Then, the acrylic resin was cured in the dental acrylic curing unit at 74°C for eight hours and left to cool at room temperature before deflasking for four hours.

For the IvoBase hybrid (Ivoclar Vivadent AG, Schaan, Liechtenstein) system, the monomer and polymer were mixed in the capsule according to the manufacturer's instructions. Then, the flask with the capsule was inserted into the injector. The IvoBase hybrid program and the "RMR" (Residual Monomer Reduction) function were selected. This program had a polymerization time of 45 minutes. Then, the flask was cooled under running water for 15 minutes before deflasking.

Inclusion criteria were specimens without any porosity on their entire surface and without any fracture of projection that duplicated the groove of the metal mold. The specimens were kept in distilled water at 37°C for two days before testing.

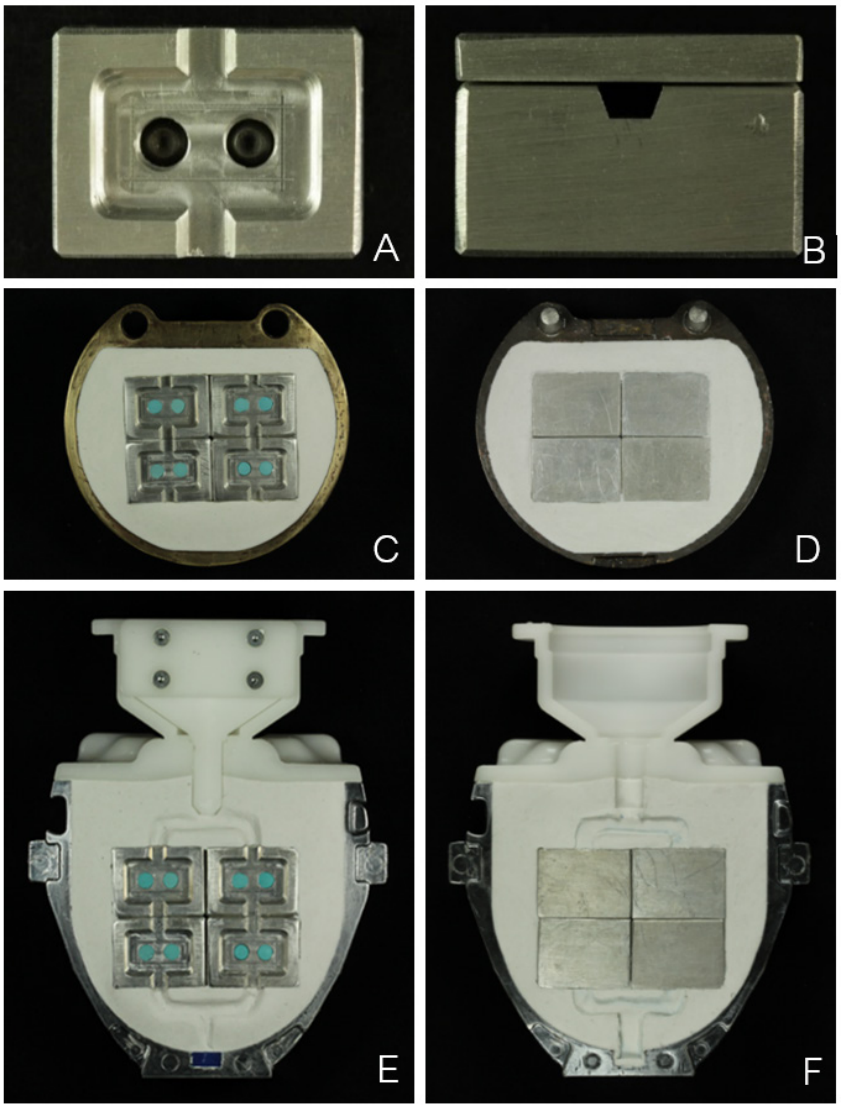

Figure 1 *(A) Rectangular steel mold had space inside with a rectangular groove at the bottom of the mold. (B) A metal lid covers the mold and shows the channel for injection molding technique. (C) Lower half flask of conventional compression technique. (D) Upper half flask of conventional compression technique. (E) Lower half flask of injection molding technique. (F) Upper half flask of injection molding technique*

2. Denture cleansers immersion

Sixty-four specimens of the heat polymerized acrylic resin and the IvoBase hybrid were divided into eight groups (n = 8). One group of each type was tested for the linear dimensional change before immersion in denture cleansers (the control group). The other three groups of each type were tested after immersion in tap water, Polident, or diluted vinegar (Fig. 2). Diluted vinegar was prepared by diluting 5 % vinegar with tap water at a ratio of 1:6.

In each group, eight specimens were immersed simultaneously in the same container which were filled with their respective denture cleansing material. All groups were immersed for five minutes and rinsed under running water for one minute. The denture cleansing materials were changed for every immersion cycle. One cycle of this method was assumed as one day of cleansing by the patient. The procedure of immersion was repeated for 180 cycles continuously. Therefore, it was supposed that the specimens were immersed for 180 days.

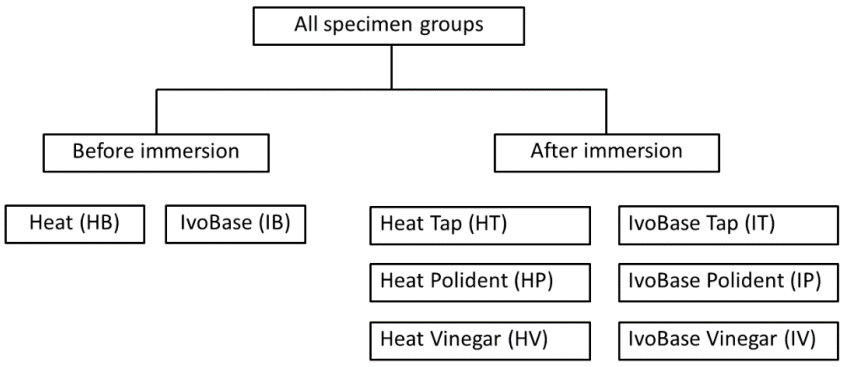

Figure 2 *All specimens groups and those abbreviations are shown in this diagram*

3. Test procedure

Four intersections at the four corners of the specimens were determined as the reference points (A, B, C, and D) (Fig. 3). A stereo-microscope (Nikon Measurescope 20, Nikon microscopes, Tokyo, Japan) was used to measure the distance between the inner corner of the intersection of each reference point; AB, BC, CD, and DA (where AB is the distance from A to B and so on). Then, the measurements of AC and BD were calculated.[22]

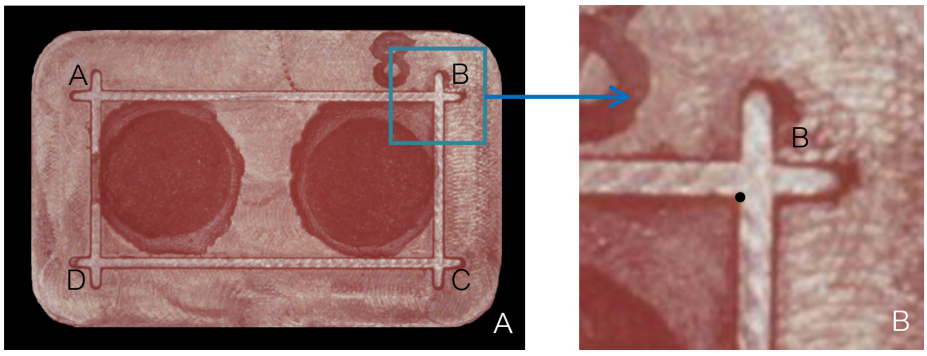

Figure 3 *(A) Four reference points on the specimen. (B) Inner corner of intersection*

The dimensional stability of acrylic resin specimens was calculated by using an algebraic norm ($\|\vec{V}\|$). It is an absolute indication of the overall dimensions of the four reference points. The algebraic norm is the square root of the sum of squares of the individual dimension.

$$\|\vec{V}\| = \sqrt{AB^2 + BC^2 + CD^2 + DA^2 + AC^2 + BD^2}$$

Then, the dimensional stability of the original metal molds for specimen fabrication (V1) was compared with that of the specimens (V2). Therefore, the differences were determined as the linear dimensional change ($|V_1-V_2|$).[5]

The independent samples *t*-test, the one way ANOVA test, and multiple comparison test were used (SPSS 19.0, SPSS Inc., Chicago, USA) to verify the significant difference at *P*-value 0.05.

Data on the linear dimensional change were statistically analyzed. For the test of normality, the Shapiro-Wilk test was used and showed that there were normal distributions. The homogeneity of variance was tested by the Levene statistic and showed that there were no significant differences. Then, the parametric ANOVA test was used, and multiple comparisons were performed by the Bonferroni test ($P>0.05$).

Results

the heat polymerized acrylic resin with the compression technique and the IvoBase hybrid with the injection technique before denture cleanser immersion

The linear dimensional change of the IvoBase hybrid (0.0402±0.0143 mm) was significantly lower than that of the heat polymerized acrylic resin (0.0761±0.0099 mm) regardless of denture cleanser immersion ($p<0.001$) (Fig. 4).

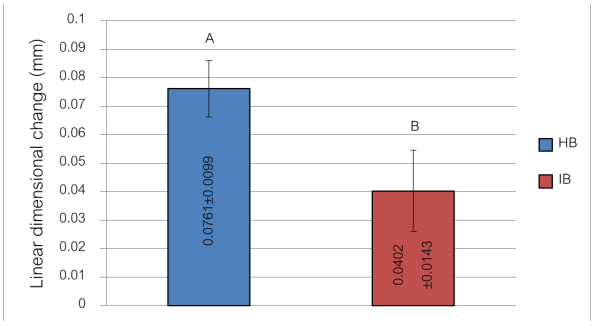

Figure 4 *Means and standard deviations of linear dimensional change of heat polymerized acrylic resin and IvoBase hybrid before denture cleansers immersion. Values with different letters are significantly different*

2. Comparison of the linear dimensional change of the heat polymerized acrylic resin with compression technique before and after 180 days of denture cleansers immersion in 180 days

For the heat polymerized acrylic resin, HB had the highest linear dimensional change (0.0761±0.0099 mm) followed by HP (0.0745±0.0109 mm), HT (0.0730±0.0098 mm), and HV (0.0661±0.0085 mm) respectively. However, the result of one way ANOVA demonstrated that the linear dimensional change was not statistically different between groups ($p=0.213$) (Fig. 5).

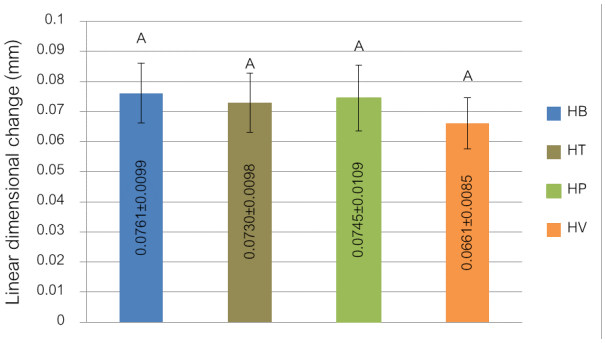

Figure 5 *Means and standard deviations of linear dimensional change of heat polymerized acrylic resin before and after denture cleansers immersion. Values with same letters are insignificantly different*

3. Comparison of the linear dimensional change of the IvoBase hybrid with injection technique before and after 180 days of denture cleansers immersion

For the IvoBase hybrid, IP had the highest linear dimensional change (0.0416±0.0081 mm) followed by IB (0.0402±0.0143 mm), IV (0.0316±0.0102 mm), and IT (0.0294±0.0091 mm) respectively. Nevertheless, the result of one way ANOVA illustrated that the linear dimensional change was not statistically different between groups ($p=0.072$) (Fig. 6).

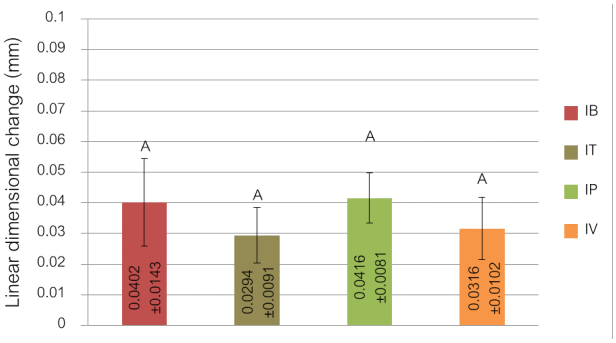

Figure 6 *Means and standard deviations of linear dimensional change of the IvoBase hybrid before and after denture cleansers immersion. Values with same letters are insignificantly different*

Discussion

In this experimental study, the linear dimensional change of the heat polymerized acrylic resin with the compression molding technique and the IvoBase hybrid with the injection molding technique was compared, as well as the effect of denture cleansers immersion on this property of the heat polymerized acrylic resin and the IvoBase hybrid was evaluated.

Based on the results of this study, the null hypotheses were partially rejected due to statistical analysis that showed a significant difference in the linear dimensional change between the heat polymerized acrylic resin with the compression molding technique and the IvoBase hybrid with the injection molding technique before denture cleansers immersion. However, there were insignificant differences in the linear dimensional change of both the heat polymerized acrylic resin and the IvoBase hybrid after being immersed in those denture cleansers.

The conventional compression technique has been used normally for the fabrication of a denture base because of its simplicity and it is considered to be the gold standard. Nevertheless, shrinkage of the denture base has been reported in this technique due to polymerization during the process. Therefore, to prevent the issue of denture adaptation, the injection molding has developed technology to solve this problem, so polymerization shrinkage was compensated by continuous pressure of the injector.[18]

The dimensional change of the denture base has been examined by using a variety of methods such as vernier calipers, gauges, comparators, micrometers, and radiography.[5] Furthermore, many factors affect the dimensional change of the acrylic resin denture base which was difficult to control[19] such as the size and the shape,[20] the denture thickness,[21] and the presence of teeth.[22] In this experimental study, the rectangular specimens were used for controlling the shape, size, and thickness of the specimens. Thus, the results of the dimensional change could be directly attributed to the acrylic resins and processing methods which were not influenced by other factors.[2,23,24]

The results of this study found that the linear dimensional change of the IvoBase hybrid with the injection molding technique was significantly less than that of the heat polymerized acrylic resin with the compression method regardless of denture cleansers immersion. This result supports the contention that the injection processing technique has less inherent processing shrinkage. The chemical composition of this material or the technique conditions, in which the dry heat and continuous application of pressure applied to the flask may be digitally controlled during the processing procedure.[23] Furthermore, the injection molding technique has less measuring errors according to a well-prepared capsule package of monomer and polymer.[9] Sykora[7] reported that the higher dimensional accuracy of the injection-molding technique, in comparison to the conventional method, may be related to the smaller resin particles compared to the conventional acrylic resin, lower polymerization temperature, the absence of resin film formation between the two halves of the flask, and the absence of displacement of the two halves of the flask during resin packing.

These results were consistent with the results of Anderson *et al.,*[23] who reported that the injection molding has less polymerization shrinkage than the compression processed resin. Furthermore, Nogueira *et al.,*[6] demonstrated that the injection molding technique produced a significantly smaller incisal pin opening, had more accuracy, reduced vertical changes, and decreased occlusal adjustment in the laboratory over the compression molding technique. Similarly, the studies of Murphy *et al.,*[25] and Gharechahi *et al.,*[5] also concluded that the SR-Ivocap injection system exhibited less polymerization shrinkage than the conventional press-pack system. Therefore, from present and previous reports it would seem that the injection molding procedure has the advantage, when

comparing dimensional change and stability, over the conventional method.

Chemical denture cleansers are essential for maintaining the prosthesis and oral health. It was found to be a better and recommended method especially in patients with poor dexterity and older people with dementia.[26] However, it should not adversely affect the properties of the denture base material itself with prolonged use.[27]

Concerning the effect of denture cleansers, this study found that denture cleansers did not significantly affect the linear dimension changes of both the heat polymerized acrylic resin and the IvoBase hybrid after 180 days of being immersed in denture cleansers. This may be due to the correct use of concentration and the duration of immersion according to the manufacturers' recommendations. Furthermore, the linear dimensional change of both resins were likely to improve after being immersed in tap water and vinegar while immersion in the Polident cleanser was similar to the control group (before immersion).

Dimensional change in acrylic resin is common. The first unavoidable dimensional change in all acrylic resin prosthesis is shrinkage that occurs during processing and finishing. The second change is an expansion which occurs when the dentures are either stored in water or is inserted in the mouth then oral fluids are absorbed.[28] A previous study had reported that water storage of acrylic denture bases resulted in expansion due to water sorption. Water sorption forces the macromolecules apart so the plasticizing effect of water allows stress to be released which results in acrylic expansion.[29] This expansion compensates for the polymerization shrinkage of acrylic resin.[30] In this study, the experimental groups were immersed in denture cleansing material that consisted of water for 180 cycles, so the dimensional change of experimental groups were improved due to the longer duration of water sorption.

Although this study revealed that Polident did not alter the dimensional change of acrylic resins, there is still controversy about other properties in relation to its long-term use. Shah *et al.,*[31] found that the flexural strength significantly decreased by using Polident for six months. Furthermore, Peracini *et al.,*[13] also reported a significant difference in the flexural strength of acrylic resin after using chemical denture cleansers for six months. However, Sharma *et al.,*[27] presented that Fittydent denture cleansing tablets did not affect the flexural strength and the surface roughness of the heat cured acrylic resin after three months of immersion. Furthermore, Sato *et al.,*[16] found that insignificant differences in flexural strength and color alteration of the heat-polymerized denture base resins after one month of soaking cycles in denture cleansing materials.

Household vinegar, used as an inexpensive chemical cleansing material, had low toxicity and antimicrobial effects. Basson *et al.,* in 1992 reported the effectiveness of undiluted vinegar solution killing adherent microorganisms.[14] Moreover, Yodsuwan *et al.,* in 2009 found a significant difference in the reduction of the colonies of *Candida albicans* in acrylic resins after one minute of soaking in 5 % vinegar diluted with tap water 1:6.[32] Furthermore, Hashizume *et al.,*[15] displayed the low cytotoxicity and biocompatibility of low concentration vinegar that was safe for denture cleansing material. Sharma *et al.,*[27] reported that undiluted vinegar did not affect the flexural strength and surface roughness of the heat cured denture base resins after 90 days of immersion. Also, Patankar *et al.,*[17] found that 50 % of vinegar was statistically insignificant, the tensile strength and color change of heat cured acrylic resin after 30 days of stimulation. This corresponds to the present study that 5 % vinegar diluted with tap water 1:6 did not alter the dimensional change of acrylic resins after 180 days of immersion.

According to the results of this study, Polident and diluted vinegar did not affect the linear dimensional change of the resins so they can be used as routine chemical denture cleansers agent for long-term use.

In this experimental study, we focused on the simple rectangular specimens. In the clinical situation, however, other factors need to be taken into account

such as shape, size, thickness, the presence of artificial teeth, and distortion when the denture is deflasked that influences the dimensional change of the complete denture. Furthermore, the effect of these denture cleansing solutions on other properties of acrylic resins should also be investigated.

Conclusions

Within the limitations of the study, the following conclusions were drawn:

- With regards to the materials and techniques on the linear dimensional change of denture base resin fabrication, the IvoBase hybrid with the injection molding technique showed a lower linear dimensional change than that of the heat polymerized acrylic resin with the conventional compression technique.

- Polident and 5 % vinegar diluted with tap water 1:6 can be used as a routine chemical denture cleanser for long-term use which does not affect the linear dimensional change of acrylic resins.

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References

1. Vojdani M, Giti R. Polyamide as a denture base material: A literature review. ***J Dent (Shiraz)*** 2015;16(1Suppl):1-9.

2. El Bahra S, Ludwig K, Samran A, Freitag-Wolf S, Kern M. Linear and volumetric dimensional changes of injection-molded PMMA denture base resins. ***Dent Mater*** 2013;29(11):1091-7.

3. Henrike V, Klaus B, Ingrid P. The effect of processing methods and acrylic resins on the accuracy of maxillary dentures and toothless denture bases: An *in vitro* study. ***Quintessence Int*** 2011;42(8):669-77.

4. Pryor WJ. Injection molding of plastics for dentures. ***J Am Dent Assoc*** 1942;29:1400-8.

5. Gharechahi J, Asadzadeh N, Shahabian F, Gharechahi M. Dimensional changes of acrylic resin denture bases: Conventional versus injection-molding technique. ***J Dent (Tehran)*** 2014;11(4):398-405.

6. Nogueira SS, Ogle RE, Davis EL. Comparison of accuracy between compression and injection molded complete dentures. ***J Prosthet Dent*** 1999;82(3):291-300.

7. Sykora O, Sutow EJ. Comparison of the dimensional stability of two waxes and two acrylic resin processing techniques in the production of complete dentures. ***J Oral Rehabil*** 1990;17(3):219-27.

8. Parvizi A, Lindquist T, Schneider R, Williamson D, Boyer D, Dawson DV. Comparison of the dimensional accuracy of injection-molded denture base materials to that of conventional pressure-pack acrylic resin. ***J Prosthodont*** 2004;13(2):83-9.

9. Cagino C. Evaluation of IvoBase (RTM) automatic injector denture processing system residual monomer reduction function [Master of Science, Department of Oral Sciences]. New York: Graduate School, State University of New York; 2015.

10. Rukkhaphan T, Kanchanavasita W, Wonglamsam A. Modification of curing technique of a 'self cure' injection molding acrylic resin: Effect on residual monomer. ***M Dent J*** 2018;38(3):305-12

11. Takamiya AS, Monteiro DR, Barao VA, Pero AC, Compagnoni MA, Barbosa DB. Complete denture hygiene and nocturnal wearing habits among patients attending the Prosthodontic Department in a Dental University in Brazil. ***Gerodontology*** 2011;28(2):91-6.

12. Pinto TMS, Neves ACC, Leao MVP, Jorge AOC. Vinegar as an antimicrobial agent for control of Candida spp. In complete denture wearers. ***J Appl Oral Sci*** 2008;16(6):385-90.

13. Peracini A, Davi LR, de Queiroz Ribeiro N. Effect of denture cleansers on physical properties of heat-polymerized acrylic resin. ***J Prosthodont Res*** 2010;54(2):78-83.

14. Basson NJ, Quick AN, Thomas CJ. Household products as sanitizing agents in denture cleansing. ***J Dent Assoc S Afr*** 1992;47(10):437-9.

15. Hashizume LN, Hoscharuk MF, Moreira MJS. Effect of affordable disinfectant solutions on Candida albicans adhered to acrylic resin for dental prosthesis. ***Rev Gaúch Odontol*** 2015;63(3):309-14.

16. Sato S, Cavalcante MR, Orsi IA, Paranhos Hde F, Zaniquelli O. Assessment of flexural strength and color alteration of heat-polymerized acrylic resins after simulated use of denture cleansers. ***Braz Dent J*** 2005;16(2):124-8.

17. Patankar AS, Meshramkar R, Nadiger R, Bagchi P. Effect of household denture cleansers on color stability and tensile bond strength of two different heat polymerized acrylic resins. ***Int J Prosthodont Endod*** 2015;5(4):95-100.

18. Yunus N, Rashid AA, Azmi LL, Abu-Hassan MI. Some flexural properties of a nylon denture base polymer. ***J Oral Rehabil*** 2005; 32(1):65-71.

19. Wolfaardt J, Cleaton-Jones P, Fatti P. The influence of processing variables on dimensional changes of heat-cured poly (methyl methacrylate). ***J Prosthet Dent*** 1986;55(4):518-25.

20. Barco MT Jr, Moore BK, Swartz ML, Boone ME, Dykema RW, Phillips RW. The effect of relining on the accuracy and stability of maxillary complete dentures - An *in vitro* and *in vivo* study. ***J Prosthet Dent*** 1979;42(1):17-22.

21. Woelfel JB, Paffenbarger GC, Sweeney WT. Dimensional changes occurring in dentures during processing. ***J Am Dent Assoc*** 1960; 61:413-30.

22. DaBreo EL, Herman P. A new method of measuring dimensional change. ***J Prosthet Dent*** 1991;65(5):718-22.
23. Anderson GC, Schulte JK, Arnold TG. Dimensional stability of injection and conventional processing of denture base acrylic resin. ***J Prosthet Dent*** 1988;60(3):394-8.
24. Salim S, Sadamori S, Hamada T. The dimensional accuracy of rectangular acrylic resin specimens cured by three denture base processing methods. ***J Prosthet Dent*** 1992;67(6):879-81.
25. Murphy WM BJ, Huggett R. A comparative study of three denture base materials. ***British dental journal*** 1982;152:273-6.
26. Nikawa H, Hamada T, Yamashiro H, Kumagai H. A review of *in vitro* and *in vivo* methods to evaluate the efficacy of denture cleansers. ***Int J Prosthodont*** 1999;12(2):153-9.
27. Sharma P, Garg S, Kalra NM. Effect of denture cleansers on surface roughness and flexural strength of heat cure denture base resin - An *in vitro* study. ***J Clin Diagn Res*** 2017;11(8):ZC94-ZC97.
28. Myung-Joo Kim C-WK. A comparative study on the dimensional change of the different denture bases. ***J Korean Acad Prosthodont*** 2006;44(6):712-21.
29. Duymus ZY, Yanikoglu ND. The investigation of solubility values, water sorption and bond strength of auto-polymerising and heat-polymerising acrylic resin materials. ***Eur J Prosthodont Restor Dent*** 2006;14(3):116-20.
30. Miessi AC, Goiato MC, dos Santos DM, Dekon SF, Okida RC. Influence of storage period and effect of different brands of acrylic resin on the dimensional accuracy of the maxillary denture base. ***Braz Dent J*** 2008;19(3):204-8.
31. Shah VR, Shah DN, Chauhan CJ, Doshi PJ, Kumar A. Evaluation of flexural strength and color stability of different denture base materials including flexible material after using different denture cleansers. ***J Indian Prosthodont Soc*** 2015;15(4):367-73.
32. Yodsuwan D. Effect of dilution of 5% vinegar on Candida albicans. ***Khon Kaen Dent J*** 2009;12(1):23-32.