KJPS Al-Kitab Journal for Pure Science
Vol.2 (2), ISSN: 2617-1260 (print), 2617-8141(online)
www.kjps.isnra.org

DOI: http://10.32441/kjps.02.02.p10

The Comparison of Retention between Hot Curing and Fluid Denture Base Acrylic Resin (In Vivo)

Bestun Luqman Akram **Rizgar Mohammed ameen Hasan**
Bestun.luqman@den.hmu.edu.krd Rizgar.hasan@den.hmu.edu.krd
Department of Prosthodontic College of Dentistry
Hawler Medical University
Erbil, Iraq

Abstract

Background and objectives: Adequate retention is a basic requirement for the acceptance of complete denture. The aim of this study was to evaluate the retention quality of fluid denture base materials and compare it with conventional acrylic denture base materials

Method: Sixteen edentulous male patients with an age 45-60 years participated in the study. For each patient two denture bases were constructed, one of them made from fluid denture base materials and the other made from hot acrylic denture base materials. A specially designed strain gauge measuring device was used to measure the force required to dislodge the two dentures from basal seats. Six measurements of retention of newly inserted denture base were recorded for each patient (three for maxillary acrylic denture base and three for maxillary fluid denture base).

Results: The results of the retention test showed that the fluid denture base materials required more force in order to dislodge denture than the heat cure denture base materials, which means a significant improvement in retention quality obtained by fluid denture base materials.

Conclusions: It has appeared that the fluid acrylic denture base materials produce denture base material with excellent retentive efficiency to the underlying tissue when compared to conventional denture base materials.

Keywords: Fluid acrylic, Heat cures acrylic, Retention test.

KJPS Al-Kitab Journal for Pure Science
Vol.2 (2), ISSN: 2617-1260 (print), 2617-8141(online)
www.kjps.isnra.org

المستخلص

الاحتفاظ الكافي هو مطلب أساسي لقبول طقم الأسنان الكامل. كان الهدف من هذه الدراسة هو تقييم جودة الاحتفاظ بمواد قاعدة أسنان السوائل ومقارنتها بمواد أسنان تقليدية من الأكريليك.

شارك في الدراسة ستة عشر من المرضى الذكور الذين يعانون من العمر مع 45-60 سنة. لكل مريض تم بناء قاعدتي أسنان, أحدهما مصنوع من مواد قاعدة أسنان السائل والآخر مصنوع من مواد قاعدة أسنان أكريليكية ساخنة. تم استخدام جهاز قياس قياس سلالة مصمم خصيصا لقياس القوة المطلوبة لإزالة الطقمين من المقاعد القاعدية. تم تسجيل ست قياسات للاحتفاظ بقاعدة أسنان تم إدخالها حديثًا لكل مريض (ثلاثة لقاعدة أسنان أكريليكية للفك العلوي وثلاثة لقاعدة أسنان الفك العلوي).

النتائج: أظهرت نتائج اختبار الاحتفاظ أن مواد قاعدة أسنان السوائل تتطلب المزيد من القوة من أجل طرد الطقم من مواد قاعدة أسنان المعالجة الحرارية ، مما يعني تحسنًا كبيرًا في جودة الاحتفاظ التي يتم الحصول عليها عن طريق مواد قاعدة أسنان سائلة.

لقد ظهر أن مواد قاعدة أسنان الأكريليك السائلة تنتج مواد قاعدة أسنان ذات كفاءة فائقة في الاحتفاظ بها للأنسجة الكامنة عند مقارنتها بالمواد الأساسية للأجهزة الصناعية.

1. Introduction

Polymethyl methacrylate (PMMA) is the most commonly used denture base resin, and its polymerization process may take place by different mechanisms[1]. PMMA was introduced in the 1930s, these resins are easy to handle, have reduced cost, and allow satisfactory clinical outcomes[2]. Several alternative methods to conventional compression-molding processing for denture base have been developed to increase the adaptation of the denture base, such as injection molding[3], and fluid resin[4] techniques. Later on, many manufacturers have introduced newer denture processing systems using light-curable and microwave-curing resins[5]. Therefore, the adaptation accuracy or dimensional changes in the denture bases has become a focus of many studies in removal prosthodontics.

Fluid resin technique employs a pourable, chemically activated resin for the fabrication of denture bases. The resin is supplied in the form of powder and liquid components. When mixed in the proper proportions, these components yield a low viscosity resin. This resin is

poured into a mold cavity, subjected to increase atmospheric pressure, and allowed to polymerize[6].

The pouring method of denture base resin was developed in the 1960s using agar hydrocolloids as investment material[7], and has been one of the most popular polymerization techniques because of three merits: It is simple to use, less time consuming, and it offers better adaptation accuracy than the heat polymerization method[5, 8].

The chemical composition of the pour type of denture resin is similar to the polymethyl methacrylate materials. The principal difference is that pour type of denture resins have higher molecular weight powder particles that are much smaller and when they are mixed with the monomer, the resulting mix is very fluid. Therefore, they are referred to as fluid resins. They are used with a significantly lower powder-liquid ratio[9].

The accurate fit of the denture base is a principal criterion in the physical mechanisms of complete denture retention [10, 11]. It is widely accepted that the successful function of a complete denture is dependent upon its accuracy of fit[12]. Denture base adaptation depends upon a number of factors, both clinical and laboratory in nature, as well as the dimensional accuracy of the material from which it is constructed[13].

The aim of this study is to the evaluation of the retention, denture adaptation and dimensional changes of maxillary denture base made from fluid denture base materials and compare it with maxillary denture base made from conventional heat-cure acrylic denture base materials.

2. Method

This study was designed to compare the amount of retention provided by two types of acrylic resin denture bases materials, the first group was 16 conventional heat cure acrylic denture base resin and the second group was 16 fluid acrylic denture base resins. The first group of dentures constructed using conventional heat cure technique and the second group of denture bases was processed using the fluid resin technique (Castlevania, Netherland).

3. Fluid acrylic resin system:

These systems of acrylic resin are generally composed of fluid acrylic resin, specially designed flask, agar-agar duplicating material and curing chamber machine. Fluid resin poured in to a mold prepared by wax elimination of a wax pattern invested by a gel material in to a special flask that possesses 3 openings, from one opening the fluid resin is poured and the air exuded through the other openings and when the fluid resin exude through these opening means that the mold has been filled. For curing, the flask will be placed in a chamber containing warm water and the pressure applies into the chamber.

2.3.1. Fluid acrylic resin (Castavaria):

This type of acrylic resin is composed of powder and liquid, the main components are methyl methacrylate, crosslinker accelerator one, accelerator two and an ultraviolet absorber. It is chemical composition monomer based on methyl methacrylate (CH2= (CH3) COOH3). Fluid acrylic resin is mixed according to manufacturer instruction in a mixing ratio by volume/parts by weight are 1 ml / 0.95 g liquid (monomer) 1.7 g powder (polymer), It needs up to 4.5 minutes till reach to the working time, Itis working time is still 13 minutes and the curing time 30 minutes at 55 °C under a pressure of 2.5 bar.

4. Retention test

Patient selection criteria

Sixteen edentulous male patients aged from 45-60 years old participated for treatment with new dentures from the clinical Prosthodontics Department, College of Dentistry, Hawler Medical University.

5. Measuring of dislodging force

For the purpose of this study, retention has been expressed in terms of the force required to vertically dislodge a maxillary denture using a specially designed strain gauge force transducer in order to measure the force values required to dislodge the maxillary denture[(14)]. The constructed experimental apparatus was consisting of the parts as shown in (Fig.1.1):

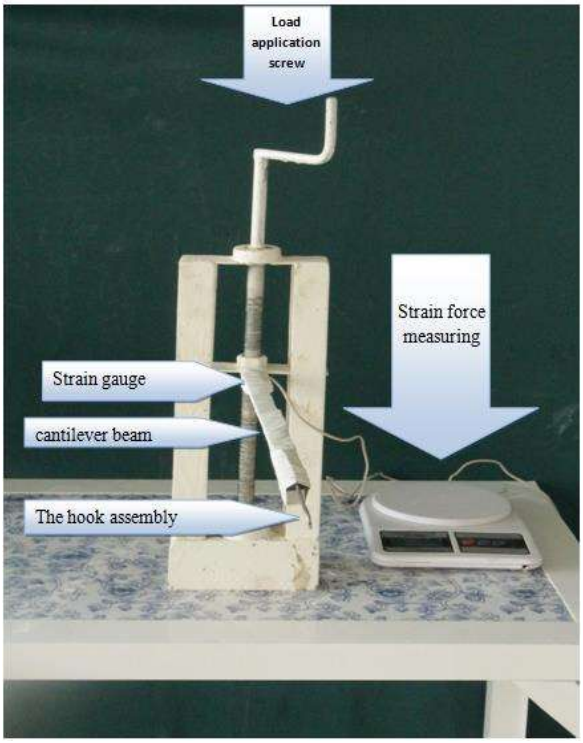

Figure (1.1): Force measuring device

6. Clinical testing

After completing the setting and calibration for the retention force measuring device, the measurement of retention force was followed by clinical testing regimen according to the following steps:

1. A string of about 1 inch length made from stainless steel was secured on the polished palatal surface of the maxillary denture in the region relating to the second premolar and first molar[12], with auto-polymerize acrylic resin so as to serve as a mean of connection for the hook assembly, as shown in Fig.(1.2).

KJPS Al-Kitab Journal for Pure Science
Vol.2 (2), ISSN: 2617-1260 (print), 2617-8141(online)
www.kjps.isnra.org

Figure (1.2): String attached to denture bases

2.Each patient asked to sit on the dental chair and to rinse his mouth by water, the denture was inserted into the mouth and held in position on the ridge by hand.

3. The patient's head was held firmly on the headrest by using two adjoining tornica and additional commercial headrest. The dental chair and headrest adjusted in such away occlusal plane of the maxillary teeth parallel to the floor, as shown in Figs. (1.3and 1.4).

Figure (1.3): Hook assembly engages strings in his patient's mouth.

Figure (1.4): Patients head was held firmly on the headrest with occlusal the plane of maxillary teeth parallel to the floor.

4. The device was then carried anteriorly till the hook assembly engages the string and properly centered in position in the patient's mouth in such a way it could travel freely to dislodge the denture from the palate, as shown in Fig. (1.5).

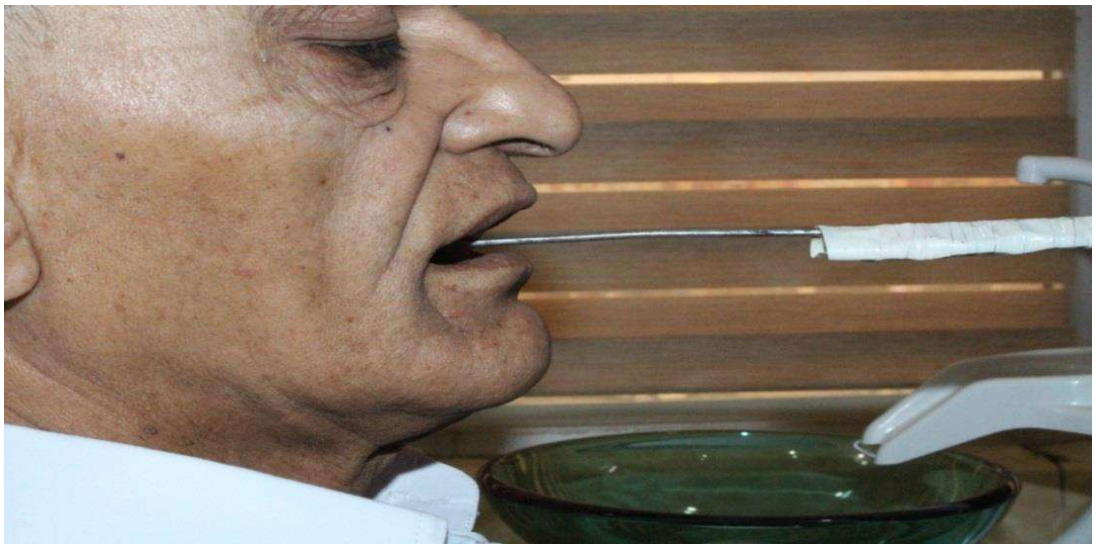

Figure (1.5): Position of the cantilever beam in relation to the patient's mouth.

5. In the same visit, the retention of the two dentures was evaluated for the patient. The conventional denture withdraws vertically at steadily increasing force until it was completely dislodged from the palate. Immediately following completion of registering the force values for the conventional maxillary complete denture, the retention of fluid denture base was recorded by using strain gauge measuring force device.

7. Method of calculation

Two measurements were made for all the patients who received new dentures. The first one was for the conventional maxillary complete dentures. The force values that required to dislodging the conventional maxillary complete denture calculated during the clinical testing and the reading were obtained by the strain-measuring device. The mean values of three readings at five-minute intervals were made for every patient, these reading served as

baseline data. The same procedure was followed for the same patients with fluid denture base materials.

8. Statistical analysis

The data were recorded into specially designed forms containing the following information: Code name, age, gender, type of denture base, and retention forces in. To facilitate the analysis and presentation of data in tables, numerical codes were assigned for each variable. Data were analyzed using Statistical Package for Social Sciences SPSS (SPSS Inc., Chicago, USA) version 23.0. Using descriptive statistics and independent-test was used for two independent samples and paired t-test (comparing one sample but in two occasions) using statistical analysis at a significance level of $P<0.05$ to compare variables between groups. All data regarding patient identification and medical history were kept confidential.

9. Results

Retention test

The retention forces for 32 maxillary denture bases (heat curing and fluid acrylic resin) s were studied on 16 patients. For each patient two dentures constructed, one fluid acrylic maxillary denture and one hot cure acrylic maxillary denture, 16 of them made from hot curing acrylic resins while the other 16 made from fluid acrylic resins.

The means of retention forces that were recorded for conventional maxillary complete denture and fluid denture base for individual patients are shown in Table (1.1). In this repeated measures study and with the purpose of eliminating possible differences in retention capacity attributable to the sequence in which the force was applied, calculations were made of the arithmetic means of the three retention force measurements.

There were substantial variations in the forces, both between patients and within patients for all measurements. The higher value among patients in conventional maxillary complete denture was 240.8 gm, while the lowest value was 155.8 gm.

The maximum reading among patients in conventional complete denture obtained for the patient among the three reading was 258.4 gm while the lowest reading recorded for the patient was 142.7 gm.

Regarding the fluid denture base, the highest value among patients was 268.9 gm, while the lower value was 170 gm.

The maximum reading of retention force among patients in fluid denture bases was 288.8 gm, while the lowest reading was 160 gm.

Table (1.1): The mean retention forces in (gm) for the conventional maxillary complete dentures and fluid maxillary denture base.

No	Mean of retention test of fluid maxillary denture base in (gm)	Mean of retention test of conventional maxillary denture base in (gm)
1	210	200.5
2	200	180
3	221.5	240.8
4	185	155.8
5	219	190.3
6	180.43	158.5
7	215.5	200.2
8	200.6	156.7
9	170	160.9
10	239.8	200.3
11	175.6	160
12	240.5	178.4
13	250.8	210.9
14	268.9	230.3
15	214	210.8
16	198.8	200
Total mean	211.9	189.65

Note: 1gm =0.0098newton

KJPS Al-Kitab Journal for Pure Science
Vol.2 (2), ISSN: 2617-1260 (print), 2617-8141(online)
www.kjps.isnra.org

The variables in this study were dependent to each other so paired samples t-test was used to indicate the difference between retention forces of the two groups of denture bases (fluid and hot), the results showed a significant difference in the mean retention when (p=0.001) as shown in Table(1.2). The mean retention forces for conventional heat cured and fluid acrylic maxillary denture base were based on 3 measurements at 3 times intervals for 16 patients. For fluid denture bases, the mean retention forces for the whole group was 211.902 gm, while for conventional acrylic maxillary complete dentures the mean retention force was 189.650 gm, retention means of fluid denture base for the whole patients were higher than retention mean of acrylic denture base made from hot curing acrylic resin.

Table (1.2): Paired t-test samples statistics comparing the mean of the retention forces exerted by two types of denture bases (fluid and heat cure).

Material	Mean (gm)	N	Minimum	Maximum	SD	SE	p	Significant
Fluid group	211.9	16	170.00	268.90	27.98	6.997	0.001	HS
Heat cure group	189.6	16	155.80	240.80	26.76	6.691		

10. Discussion

In the present study two types of denture bases were constructed for each patient (heat curing and fluid acrylic denture base), the fluid denture bases had shown more resistance to the displaced forces and an increase in the mean of the retention forces in comparison with conventional heat curing acrylic denture base, this increase in retention mean was statistically significant (Table 1.2).

One of the causes may be due to the fluid acrylic resins did not require the application of thermal energy to initiate material polymerization. Instead of heat, chemical activators are added to the material and polymerization can be completed at room temperature, the processing is similar to that for heat cured resins, except that the flask is left at room temperature[(11)].

On the other hand, another factor which makes the fluid acrylic to show higher retention force may be due to the type of the investment material that had been used in this study; the agar-agar investment material used for the fluid denture bases and dental stone investment material used for the heat cured denture bases. Denture produced by agar-agar investment material may produce a surface with less porosity, more accurate and, more adaptable.

Another causative factor that made fluid acrylic denture bases provide more retention quality may be due to the simplicity in the procedure of finishing and polishing, which was only needed ground away the pouring channel with a metal bur and less finishing time and no warpage formed when compared to the heat cured denture bases, that means less heat generation produced during finished time, less dimensional change occurred and more adaptable denture base produced.

On the other hand, another factor may be due to the internal strain during produced packing procedure, when the acrylic resin flashing procedure is performed under routine laboratory conditions, the flask is placed in traditional clamps after final pressing in a hydraulic press. This condition may lead to a release of residual internal stresses from the acrylic resin dough before polymerization. The release of residual internal stress along with polymerization shrinkage, thermal contraction during flask cooling and strain accompanying stress release during deflasking may cause diminished adaptation of the denture to the tissues[15], the amount of strain in a denture will depend upon the shape and size of the samples, the types of separating medium used, the rate of heat application, the temperature range attained during polymerization, the rate of cooling after processing and the type of treatment during finishing and polishing[16], while the fluid denture base poured in to the sprue holes directly without any press, therefore there was not produce internal strain, less polymerization shrinkage, during cooling there was no produce strain, and finally produce denture with more adaptable and retentive quality when compared to the conventional heat curing denture base.

11. Conclusion

Fluid denture base has more retention than heat-cure denture base in the static state.

References

1. Powers. RG, Craig. Restorative dental materials. 11th ed. ed.; London: St. Louis: Mosby. 2002;347.
2. Craig RG. Restorative Dental Materials. St. Louis: Mosby,1993 Sep. 478.
3. Pryor WJ. Injection molding of plastics for dentures. The Journal of the American Dental Association. 1942;29(11):1400-8.
4. Fairchild J. The fluid resin technique of denture base formation. Journal-California Dental Association. 1967;43(2):127.
5. Takamata T, Setcos JC, Phillips RW, Boone ME. Adaptation of acrylic resin dentures as influenced by the activation mode of polymerization. The Journal of the American Dental Association. 1989;119(2):271-6.
6. Maryanchik I, Brendlinger EJ, Fallis DW, Vandewalle KS. Shear bond strength of orthodontic brackets bonded to various esthetic pontic materials. American Journal of Orthodontics and Dentofacial Orthopedics. 2010;137(5):684-9.
7. Shepard WL. Denture bases processed from a fluid resin. The Journal of prosthetic dentistry. 1968;19(6):561-72.
8. Goodkind RJ, Schulte RC. Dimensional accuracy of pour acrylic resin and conventional processing of cold-curing acrylic resin bases. The Journal of prosthetic dentistry. 1970; 24(6):662-8.
9. Manappallil JJ. basic dental materials. 2nd ed. ed. New Delhi: Jaypee medical publisher. 2003;153.
10. Anthony D, Peyton F. Dimensional accuracy of various denture-base materials. The Journal of Prosthetic Dentistry. 1962;12(1):67-81.
11. Darvell BW. Acrylics. In: Darvell. B, editor. Materials Science for Dentistry. 9th edition ed. United Kingdom.: Wood head publishing.; 2009. 108-27.
12. Green AJ, Harman L. Influence of diuretics on complete denture retention: a preliminary report. The Journal of prosthetic dentistry. 1980;43(5):506.
13. Zissis A, Huggett R, Harrison A. Measurement methods used for the determination of dimensional accuracy and stability of denture base materials. Journal of dentistry. 1991;19(4):199-206.
14. Abdulkareem HS. Comparison between Retention of Maxillary Acrylic and Nylon Denture base Materials. College of dentistry, Hawler Medical University. ; 2010;40-4.
15. Lechner S, Thomas G. Changes caused by processing complete denture. J Prosthet Dent. 1951;1:551-9.
16. Woelfel J, Paffenbarger G, Sweeney W. Dimensional changes occurring in artificial dentures. Int Dent J. 1959;9(4):451-60.