Comparison of Dimensional Accuracy of (Pmma) Denture Base Material Relined With Molloplast B Soft Liner By Different Curing Methods.

Radhwan H Hasan [(1)], Shilan H Fatah [(1)]

Background and objectives: The most common problem associated with the complete denture is the loss of retention after period of time therefore relining procedure is important in many cases, this study was done to compare the dimensional accuracy of PMMA before and after the application of Molloplast B Soft liner to the denture base material by different curing methods.

Methods: A total of 80 PMMA samples were used in this study, 40 (SR Triplex hot) PMMA samples polymerized in water bath, 40 (Acron MC) PMMA samples polymerized in microwave, Molloplast B soft liner (Detax, Germany) were packed between each two PMMA strip as overlap joint and cured by water bath and microwave, the dimensional accuracy of PMMA samples were measured before and after the Molloplast B soft liner application using the (DOF scan app) software device.

Results: The results showed that the dimensional accuracy of SR Triplex hot water bath polymerized PMMA samples experienced significant dimensional change after the application of Molloplast B soft liner, while in Acron MC microwave polymerized PMMA samples, non-significant dimensional changes were observed after Molloplast B soft liner application.

Conclusion: Microwave polymerized PMMA samples showed better dimensional accuracy than the water bath polymerized PMMA samples after the addition of Molloplast B Softliner.

Keywords; PMMA, Soft Liner, Microwave, Water Bath

[(1)] Department of Prosthodontics, College of Dentistry, Tishk international University, Erbil, Iraq.
Corresponding author: Shilan H Fatah
email: shilan.hameed@tiu.edu.iq

INTRODUCTION

Applying Molloplast B soft liner to the PMMA dentures requires second polymerization procedure of the PMMA denture bases, which may cause distortion and shrinkage to the PMMA denture base.[1] The dimensional accuracy of the PMMA is important for obtaining a close fit to the soft oral tissues and, consequently, gaining a reasonable denture retention, attaining a correctly functioning denture, maintaining healthy oral tissues and ensuring the comfort and satisfaction of the patient, [2,3,4] Recently many materials and polymerization techniques have been developed for PMMA polymerization and soft liner curing to avoid dimensional shrinkage. [5,6,7]

Literature studies have suggested numerous methods to determine the dimensional accuracy of the PMMA dentures, which include the use of

comparator or micrometer microscopes, vernier or digital calipers, and computer-assisted coordinate measurement systems. [8] Several studies measured the dimensional accuracy of PMMA acrylic resins by making fixed reference points on the PMMA acrylic denture base (AB, AC, and BC) and measuring the distance between these reference points before and after thermocycling, water bath polymerization technique, disinfection by microwave, water immersion or applying the soft liner, [9,10] suggested the use of optical comparators (Deltronic DH14 Profile Projector, Deltronic Corp., Santa Ana, Calif.) under 10x magnification with a traveling stage calibrated to 0.002 mm, and using a fiber-optic light source to determine and align certain reference points on the PMMA samples and make the measurements easier. Harrison recommended the use of computer-assisted coordinate measuring machines (CCMM's) to measure the dimensional accuracy of PMMA acrylic resins and reported that they are one of the most accurate systems, along with digital calipers and optical comparators. Such machines also come with a scanning mode which helps to find and identify potential contour changes in dentures, which come particularly accessible when considering two-dimensional changes. [11] Vallittu measured the PMMA denture bases after they were polymerized with water bath using digital micrometers (NSK Mac-Cal, Japan Micrometer, Osaka, Japan) with up to 6.4x magnification light microscope. [12] Many authors measured the dimensional accuracy by making holes over crest ridge of a brass dye cast with pointed head having intimate fit, to serve as reference points as A, B, C, D and E. with intimately fitting stainless steel pins which were transferred to the intaglio surface of dentures during the fabrication of denture bases, The pins were placed in the holes with the head facing down toward the standard brass cast holes. Nikon optical comparator with profile projectors (Nikon Model 6C; Nippon Kogaku KK, Tokyo, Japan), traveling or digital microscope were used to measure the distances between different points of the standard brass casts. [13,14,15,16] Fenlon used commercial metrology scanning software by scanning the intaglio surface of the dentures, and rescanning them in the identical fashion of the first scan to evaluate differences between pairs of two scans. [17] Despite all these studies and methods suggested by the authors, the dimensional change test remains a phenomenon that requires further study and explanation.

METHODS

Study design:

This study was a comparative and experimental study, it was conducted on Molloplast B soft liner material, and two types of PMMA material (SR Triplex hot, Acron MC), the (SR Triplex hot, Acron MC) were compared for their dimensional accuracy.

Main study groups: Eighty PMMA samples (160 PMMA strips) were prepared from the two brands of SR Triplex hot water bath and Acron MC microwave PMMA: the first forty samples of SR Triplex hot water bath polymerized PMMA were polymerized in metal flask in water bath, other forty samples of Acron MC microwave polymerized PMMA were polymerized in FRP in domestic microwave oven. The Molloplast B soft liner were cured by two techniques, water bath technique and microwave technique, attached between every two PMMA strips, samples measured by the dimensional accuracy test, before and after the application of the Molloplast B soft liner. A precise master metal plate was constructed by Haas milling machine with the dimensions (50 x 10 x 3) mm length, width, thickness respectively, [18] with four points 2 mm away from the metal plate edge and 4mm between each poin for the dimensional accuracy test. [19] Figure 1. One hundred sixty pattern were prepared with mentioned dimensions by fixing two layers of polywax together and cutting them along with the master metal plate which was used as a frame with the same dimension of the PMMA strip.

Classification of study groups according to PMMA polymerization, Soft liner curing technique, Each group consisted from 20 samples.

G1 AWL	Lased SR Triplex hot water bath polymerized PMMA with water bath cured Molloplast B soft liner
G2 AWS	Sandblasted SR Triplex hot water bath polymerized PMMA with water bath cured Molloplast B soft liner
G3 AML	Lased SR Triplex hot water bath polymerized PMMA with microwave cured Molloplast B soft liner
G4 AMS	Sandblasted SR Triplex hot water bath polymerized PMMA with micro-wave cured Molloplast B soft liner
G5 BWL	Lased Acron MC microwave polymerized PMMA with water bath cured Molloplast B soft liner
G6 BWS	Sandblasted Acron MC microwave polymerized PMMA with water bath cured Molloplast B soft liner
G7BML	Lased Acron MC microwave polymerized PMMA with microwave cured Molloplast B soft liner
G8 BMS	Sandblasted Acron MC microwave polymerized PMMA with microwave cured Molloplast B soft liner

A*:SR Triplex hot water bath polymerized PMMA

B*: Acron MC microwave polymerized PMMA

W*: water bath cured Molloplast B soft liner

M*: Microwave cured Molloplast B soft liner

L*: Nd:YAG laser treated PMMA samples

S*: AL 2 O3 Sandblast treated PMMA samples

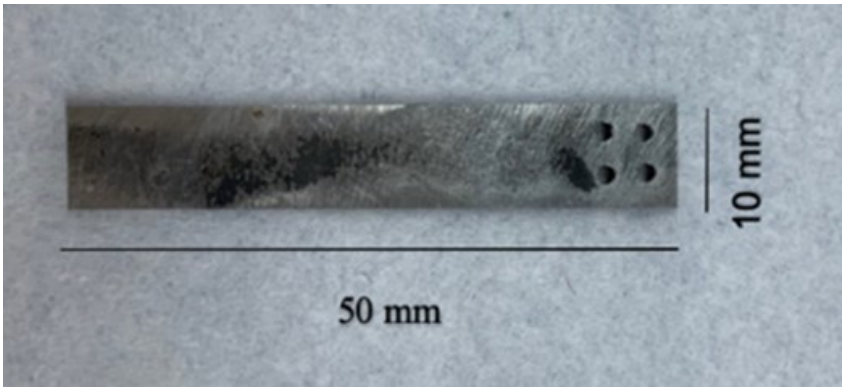


Figure 1: Master metal plate

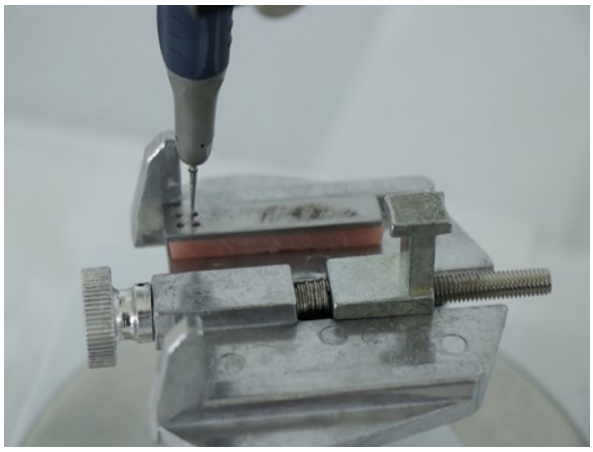
Preparation of the samples for the dimensional accuracy test

Eighty PMMA strips were prepared for dimensional accuracy By drilling points on the PMMA strips using the master metal plate (50x10x3) mm length, width, thickness respectively. In order to put the points on their preferred position on PMMA strips. The points were drilled 2 mm away from the PMMA strip edge and 4mm distance were kept between the points according to the metal master plate which was mentioned previously in wax pattern preparation, with the aid of handpiece which was fixed to the dental surveyor. Master metal plates were attached to the PMMA strips, to ensure parallelism and standardization for all points position for all PMMA strips. These points were drilled by the specific bur in a fixed hand piece in the same standard for the rest of eighty PMMA strips Figure 2,3. The points were named as A, B, C, D orderly. As a standardization for all PMMA strips, Figure 4, these points were made to be used and measured as fixed reference points before applying the Molloplast B soft liner. Later on, each drilled PMMA strip was attached to another undrilled PMMA strip after applying the Molloplast B soft liner therefore, the final study sample was produced. [12]

Figure 2: H.P fixed on dental surveyor

Figure 3: Drilling the points on the PMMA strips

through the constructed metal frame by the H.P fixed to dental surveyor.



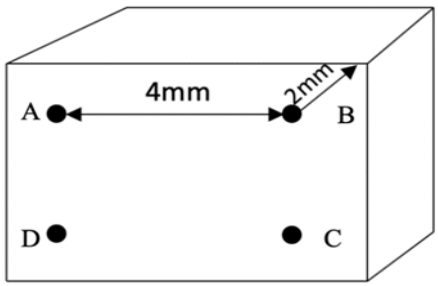


Figure 4: Dimensional accuracy sample point

Figure 5: PMMA in FRP flask after removing the glass spacer.

Dimensional accuracy-test: All the eighty drilled PMMA strips were scanned one by one with Freedom HD scanner

Figure 6: applying the Molloplast B soft liner to the PMMA surfaces .

prior the addition of Molloplast B soft-liner and after the addition of Molloplast B soft liner. To check whether the second curing of the PMMA may cause any dimensional change to the PMMA samples. The samples were scanned in freedom HD scan device for 3 minutes to obtain 0.0001 accuracy with DOF scan app software figure (7), measurements were taken between the 4 points of the PMMA. Six measurement were taken for each sample between four points labeled (A,B,C,D). Measurements of the samples were recorded in the excel software after measuring the distance between reference points AB, BC, CD, AD, AC, BD figure (8). The algebraic norm was using the square root of sum of squares of individual dimensions: Norm= $\sqrt{AB2+BC2+CD2+AC2+AD2+BD2}$. [19] as a conclusion only one measurement obtained from the algebraic norm for each sample, one measurement before applying the Molloplast B soft liner and the other one after applying the Molloplast B soft liner, in order to compare the change that might occurred between first and second measurement Figures 5,6).

Figure 7: CAD/CAM (DOF scanner software and Freedom HD scanner.

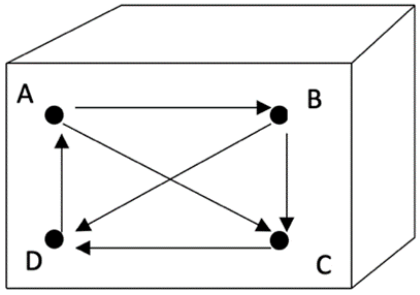


Figure 8: A B C D points on samples

Results Paired t-test was done to see if there was a difference between measurements of PMMA samples before applying the Molloplast B soft liner and measurements of PMMA samples after applying the Molloplast B soft liner (Table 1). Descriptive statistics show the mean and ± Standard deviation (SD) measurements of PMMA samples with minimum and maximum range and between lower and upper bounds of the whole groups samples before and after applying the Molloplast B soft liner. Measurements of PMMA samples before applying the Molloplast B soft liner of the whole groups was 10.32 ± 0.24 mm, ranging from 9.52 to 11.01 mm, not exceeding the lower and upper bond 10.21mm to 10.38 mm**.** All studied group PMMA samples of the groups have significant dimensional change in after applying the Molloplast B soft liner except group BM group (Acron MC microwave polymerized PMMA with microwave cured Mol-

loplast B soft liner, BM (Acron MC microwave polymerized PMMA with microwave cured Molloplast B soft liner) as shown in Figure 9.

Table 1: Dimensional accuracy test before and after second polymerization.

Descriptive statistics of dimensional accuracy test after applying the soft liner.

DISCUSSION

		PMMA measurements after applying the Molloplast B soft liner (mm)			95% Confidence Interval for Mean			
	N		SD	SE	Lower Bound	Upper Bound	Min.	Max.
G1: AWL	10	10.20	0.12	0.04	10.11	10.29	9.94	10.34
G2: AMS	10	10.10	0.20	0.06	9.96	10.24	9.68	10.34
G3: AML	10	10.19	0.11	0.03	10.11	10.26	10.00	10.30
G4: AMS	10	10.19	0.11	0.03	10.11	10.26	10.00	10.30
G5: BWL	10	10.15	0.14	0.04	10.05	10.25	9.92	10.36
G6: BWS	10	10.20	0.17	0.05	10.07	10.32	9.96	10.45
G7: BML	10	10.40	0.22	0.07	10.25	10.56	9.98	10.82
G8: BMS	10	10.05	0.38	0.12	9.77	10.32	9.23	10.63
Total	80	10.18	0.21	0.02	10.14	10.23	9.23	10.82

*By paired t test.

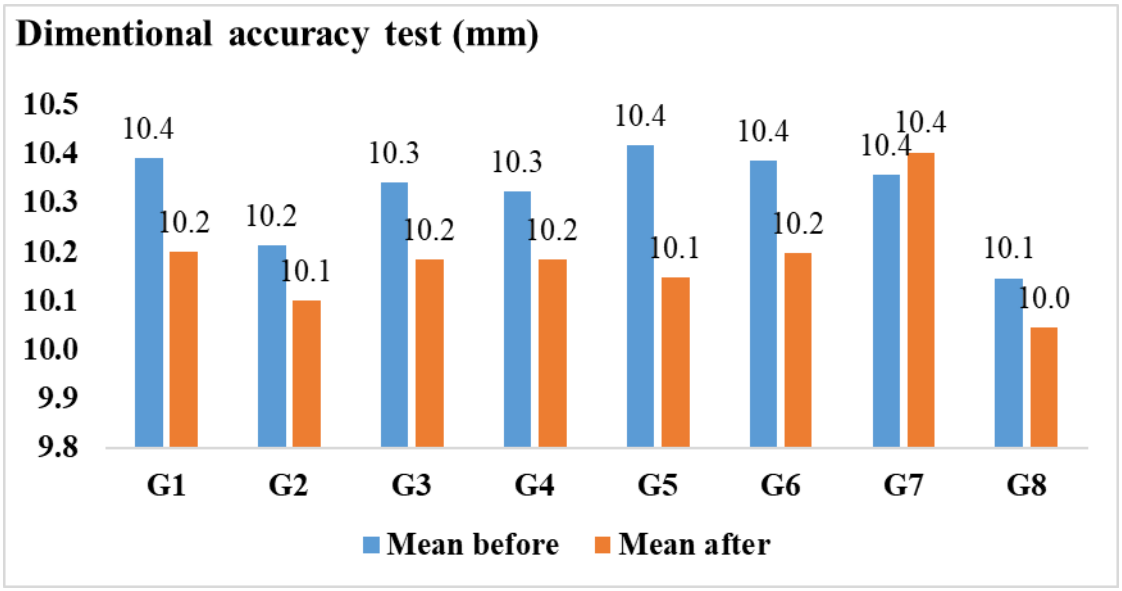


Figure (9): Dimensional accuracy test before and after second polymerization.

Dimentional accuracy test due to the high accuracy of the software which can measure (0.0001) mm with low factor error (DOF CAD/CAM) software has been provided to measure the samples before and after applying the Molloplast B soft liner. In addition, this device has been used for the first time for measuring dimensional accuracy because previous studies used accurate methods like digital Vernier, scanning with digital cameras, microscopes, Graphics Coordinate Measurement System.[8] Results of the present study showed that water bath curing technique of soft liners in (G1 ,G2, G3, G4, G5, G6) showed significant difference in PMMA samples after applying the Molloplast B soft liner ($p > 0.005$), while microwave curing technique of soft liners in (G7 ,G8) showed a nonsignificant difference between PMMA samples measurements before and after applying the Molloplast B soft liner ($p < 0.005$) as shown in (Table 1)(figure 9). According to the results of the present study, microwave polymerized (Acron MC) PMMA did not cause dimensional change to PMMA, while the water bath polymerized (SR Triplex hot) PMMA caused distortion, Results of this study were supported many authores. [21-24] Other conflicting results showed that microwave irradiation caused dimensional inaccuracies and distortion to the PMMA dentures, and preferred the water bath polymerization over the microwave polymerization.[7,25,26] The reason behind the Dimensional change in water bath polymerized PMMA may be due to thermal or polymerization shrinkage because when MMA is converted to PMMA it undergoes a volumetric shrinkage of around 20-21 %. The majority of dimensional changes that occur on PMMA take place during their curing process, water sorption may also lead to the dimensional change of water bath polymerized PMMA, because PMMA tends to absorb water and to expand slowly over a while.[27] Some authors have mentioned that a short polymerization cycle may include the PMMA material to boiling temperatures fast which leads to dimensional inaccuracy. [28] Regarding the limitation of the study, the sample design of the present was prepared to resemble the clinical condition in patient mouth during masticatory force application that may cause debonding of soft liner from the PMMA denture base. This study was only done in vitro study, the PMMA denture material and the molloplast B soft liner material were not examined in patient mouth temperature, or under masticatory load. This study was done only done on Molloplast B softliner (silicone based soft liner), in addition the dimensional accuracy test was not examined after storing them in water after different period of time so this study did not include the aging of the material.

CONCLUSION

In SR Triplex hot water bath polymerized PMMA denture base material there is a significant difference in dimensional change test before and after applying the Molloplast B soft liner, while in Acron MC microwave polymerized PMMA denture base material there is no significant difference in dimensional change test before and after applying the Molloplast B soft liner material.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest relevant to this article.

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