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The Effect of using Iraqi Plaster with Type III Dental Stone as Investing Materials on the Vertical Dimension of Occlusion in Acrylic Resin Complete Dentures (A comparative Study)

Rajaa M. Al-Musawi[1] Akhlas Z. Al-Taai[2] Mohammed T. Al-Khafagy[3]
1.Department of Prosthodontic; College of Dentistry; University of Kufa
2.Department of Prosthodontic; College of Medical and Health Technology/Baghdad
3.Head of department of Prosthodontic; College of Dentistry; University of Kufa

Abstract
Aim of study: The aim of this study was to evaluate the Iraqi plaster when used as investing material and studies its effect on the changes of vertical dimension of occlusion of heat cured acrylic resin complete dentures using four different investing methods in compression molding technique.Materials and methods: Forty acrylic resin complete dentures were prepared from heat-cure acrylic resin denture base. The study include 4 groups depending on the type of investing method, Group 1: plaster- stone- mixed, Group 2: plaster- stone- plaster, Group 3: plaster- mixed- mixed, Group 4: plaster- mixed - stone. Each group of them contains 10 dentures. Changes in occlusal vertical dimension were measured before and after denture processing. Collected data were analyzed with analysis of variance and Tukey's test at 95% level of confidence (p=0.05).Results: The mean of changes in dimension of occlusion in different groups were: group1: (0.6337mm), group2: (0.6253mm group3: (1.0171mm), and group4: (0.9837mm).Conclusion: Less dimensional changes was observed in the group of dentures that invested with plaster-stone- plaster when compare with other investing methods.
Keywords: Iraqi plaster, stone, flasking, vertical dimension of occlusion.

Introduction

Maintaining achieved occlusal scheme from the time of the try-in appointment until delivery has always been a difficult goal in complete denture prosthodontics (1). The evaluation of tooth displacement has been important in seeking a more stable occlusal pattern, retention and functional quality of complete denture (2).

Poly (methyl methacrylate) is the usual resin employed for manufacturing dentures. Since its introduction over six decades ago, there has been a continual search to modify the processing procedures of the resin to improve not only physical and mechanical properties, but also the working properties that facilitate laboratory techniques of denture construction (3).

Dimensional changes in the base can be influenced by polymerization shrinkage, the resin flasking method, and the time-temperature correlation during the polymerization procedure (4).

Several techniques are utilized in resin polymerization method, pouring method, injection pressing method, and microwave activated polymerization method. Improvements have been made in each method to strive towards a system with high accuracy and reliability (5,6).

Although there are some priorities for these techniques over the conventional packing method but some investigators found no significant advantages over conventional packing (7).

So many processing methods have been developed for the purpose of minimizing polymerization shrinkage, but some warpage after processing is inevitable, the results suggest that a gradual cooling course for 12 hrs or more after processing a heat-activated acrylic denture base is effective for lessening deformation of the prosthesis. (8). To overcome these undesirable processing effects, various flasking polymerization techniques and materials had been studied (9).A mix of dental stone is placed over the surface of the teeth in the invested trial denture, which is referred to as "coring" to make trial packing possible without distorting the acrylic resin of the veneers (10) . Although they are not directly used as dental restoratives, gypsum products are important adjunct materials used in many clinical and laboratory procedures (11).

In the present study Iraqi plaster was used as investing materials with stone to made four different investing methods in compression molding technique and compare changes in vertical dimension of occlusion of simulated complete dentures when using these four different investing methods.

Materials and methods:

Forty complete dentures were fabricated as the same method as described by Mosharraf et al (12).By using a silicone mold (Zetalabor, zhermack, Rovigo, Italy), forty sets of identical maxillary and mandibular stone casts (pasom, Dental product, SP Brazil) were obtained.

Semi-adjustable articulator (Pars-Dandan PA-DA Iran) was used to mounting one set of casts. After that the acrylic resin denture teeth (Pigon teeth MFG. Co, LTDMDD-Europe) were arranged in conventional balanced occlusion (condylar guidance angle set at 30 degrees, incisal guidance angle at 8 slight compensating

curve was maintained (, then waxing of maxillary and mandibular dentures was made. The thickness of the palate in maxillary waxed denture was maintained of 2mm. the other dentures were duplicated using silicone duplicating material (Ormamax light, Italy).

To provide enough rigidity for the duplicating material, it supported by custom flask made from auto-polymerizing poly methyl methacrylate (Pan acryl-self cure acrylic -Istanbul). Each mold will have two sprue holes, so when placing the teeth and prepared stone casts in the silicone molds, molten base plate wax was poured in to the molds throw these holes then, allowed to cool at room temperature (21°C± 2°C) for 2 hours before removal.

A cork cup is used as a jig to keep the sets of test dentures in the same position that the master dentures occupied on the articulator, the maxillary denture mounted on the articulator as a guide (figure1). The same mounting method was used for each test denture. Small corrections may be needed to complete the occlusion of denture teeth. The obtained denture occlusion had at least 10 contact points on each side of the arch to get minimum of (7) posterior and (3) anterior contacts in protrusive and lateral movement. After positioning of the articulator on a table, digital caliper, capable of registering changes as small as 0.01mm was used to measure the distance between upper and lower members of the articulator. Two vertical measurements were made: the initial one with the experimental denture waxed-up and the final one after the dentures had been processed. Changes in vertical dimension of occlusion (VDO) in this report correspond to the difference between the final and initial measurement.

Dentures were flasked according to conventional flasking technique (fig 2) in four groups: - Group (1): The lower part of flask was filled with Iraqi dental plaster (Iraqi gypsum Company Ltd the almalage -Iraq) and the second layer of investing media was made with pure type III dental stone up to occlusal surface of denture teeth and the remaining part of flask was filled with third layer which was made from 50-50 mixture. Group (2): The first two layers were the same as that of group (1) while the third layer made of Iraqi dental plaster.

Group (3): the lower part of the flask was filled with Iraqi dental plaster and the upper portion was filled with 50-50 mixture of plaster and type III dental stone in one layer.

Group 4: the lower part of the flask was filled with Iraqi dental plaster and the second layer was made with 50-50 mixture of Iraqi dental plaster and type III stone, while the third layer was filled with pure dental stone.

Heat cure acrylic resin (pan acryl-Heat cure acrylic-Istanbul) was mixed according to the manufacture instruction and when reaches to the dough stage, experimental groups were compression molded with it.

The samples were cured in a curing machine (Thermotron Dental Products, Piracicaba SP, Brazil) by using conventional flask pressure technique at 72°C for a 9 hours. A pneumatic press was used for trial packing each denture initially at 1500 psi and with the final closer of 3500 psi maintained of 30 min (12). After completing the curing, gradual cooling to room temperature was required, then the flask was opened and the processed dentures were removed from the investing material. Flashes of acrylic were removed with an acrylic bur and adherent stone was cleaned on the teeth and mounting rings (13). The upper cast and dentures was then repositioned on the articulator using the split cast technique to facilitate accuracy of the final measurement.

The usual statistical methods were used in the present study in order to asses and analyze the collected data and they include, one way analysis of variances (ANOVA) and Tukey's test at 95% level of confidence (P=0.05).

Figure 1: Mounting Jig

Figure 2: Conventional flasking technique.

Results

Descriptive and inferential statistics for changes in vertical dimension of occlusion for heat cure acrylic resin experimental groups as influenced by investing with four different investing methods then compare between the results of them to evaluate the Iraqi plaster as an investing material. The results showed that the lowest mean value of VDO changes was obtained in group (2): (Iraqi dental Plaster- dental stone- Iraqi dental plaster), while the highest mean value of VDO changes was obtained in group (3): (Iraqi dental plaster - 50-50 mixture of plaster and type III dental stone) (fig 3).

One way ANOVA with Tukey's test between tested groups in each investing method are indicated, the results indicate a significant difference at ($P<0.05$) when compare between group (1 and 2) in one hand and group (3 and 4) in the other hand, while there is no significant differences between group (1 and 2) and between group (3 and 4).

Table 1: Descriptive and inferential statistics for changes in vertical dimension of occlusion for heat cure acrylic resin

Groups	Mean (mm)	Standard deviation	Standard error
G1 (P-S-M)	**0.6337**	**0.00796**	**0.0025**
G2 (P-S-P)	**0.6253**	**0.0122**	**0.0039**
G3 (P-M-M)	**1.0171**	**0.0511**	**0.016**
G4 (P-M-S)	**0.9837**	**0.0340**	**0.011**

P = Plaster.
S = Stone.
M = Mixed of plaster and stone.

Table 2: Least Significant Difference

Groups	P- value			
	G1	G2	G3	G4
G1		**0.09**	**★0.0005**	**★0.0005**
G2			**★0.0001**	**★0.0005**
G3				**0.106**
G4				

(★ Significant $P<0.05$)

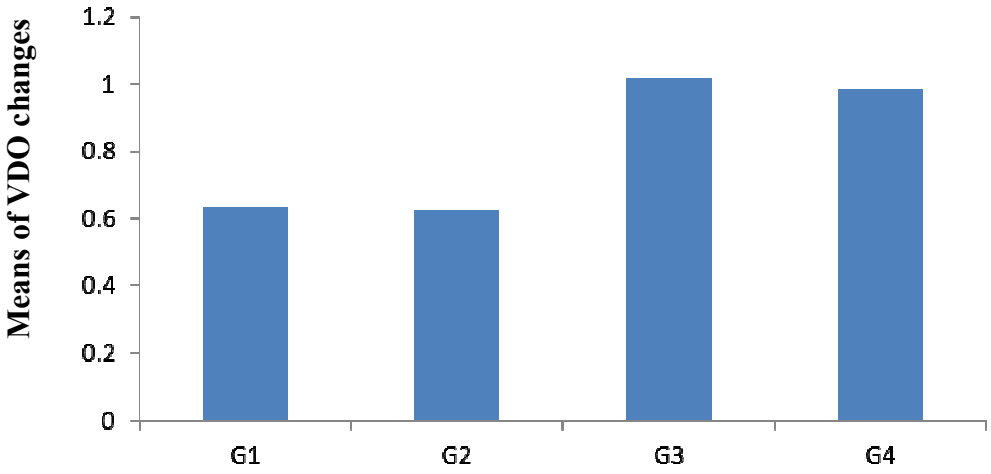

Figure 3: Bar chart of VDO changes mean values in mm.

Discussion

Processing the denture base materials produced unequal deformation in different dimensions (anterior-posterior and cross-arch)(14). The dimensional characteristics of processed denture base are affected by many factors, these are: type of acrylic; type of investing medium selected; method of resin introduction; and temperature used to activate polymerization process (15).

In the present study, the effect of four types of investing method, on the VDO was evaluated. The results showed that lowest mean value of VDO changes was seen in groups (2) and the highest in value of VDO changes was seen in group (3). The result also revealed that there were no significant differences between group (1 and 2) and between group (3 and 4), on the other hand there was a significant differences between group (1 and 2) when compare with group (3 and 4). The lower dimensional changes in group (1 and 2) may be due to investing the waxed denture with pure dental stone.

This is agrees with Sinclair (16) when he stated that the most accurate results in maintaining the VDO of dentures during processing were obtained with artificial stone and a layer of silicone rubber. This evidence is also approved by Baydas (17) as he attributed the least dimensional changes observed in the specimens was made with dental stone as flasking material, Turakhia (18) observed that when dentures were flasked in only dental plaster maximum movement of the teeth was measured, whereas dental stone when used as the coring material over the teeth and polished surface showed the least movement of teeth during processing. He said that this is so because dental stone due to its rigidity binds the teeth to gather and prevents them from the moving. Mosharraf et al (12) showed that the least vertical opening and a complete absence of occlusal changes occurred in the dentures invested in the plaster of Paris core with an artificial stone cap. Al-aloos and Abdul Fatah (1) showed that the rigid produces the least amount of shrinkage in the vertical distances compared to other resilient investments used in their study. The significant difference between group (1 and 2) on one hand and group (3and 4) on the other hand may be due the use of mixed gypsum for investing waxed denture. Mixed gypsum can cause dimensional changes by itself or does not have sufficient strength to prevent teeth movement.

Because it contain plaster, this result was agrees with Jhon (19) as he said that the strength of model plaster is approximately 2.3MPa.While the strength of dental stone is twice than that of plaster.

Conclusion

This study demonstrated that dental stone is still the best choice for investing the acrylic denture base resin when compare with other types of investing materials in conventional molds technique.

Clinical significance

For economic point of view, the Iraqi plaster can be used as investing material for flasking of heat cure acrylic with acceptable properties regarding verticals dimension of occlusion of acrylic resin complete dentures.

Correspondence to

Dr. Mohammed T. Alkhafagy, Associate professor and head of department of Prosthodontic, College of Dentistry, University of Kufa.

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