Original Research

Effect of Stone Cast Type on Complete Denture Base Adaptation

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Abstract

Introduction: Few researches have been conducted researches on the influence of the type of dental stone used for fabrication of casts on the adaptation of denture bases. The purpose of this study was to compare the effect of two types of stone casts on the accuracy of fit in complete denture bases. **Methods:** Using sixty fully replicated master casts obtained by duplicating a metal die representing an edentulous maxillary arch, 30 casts were poured in type III dental stone and 30 made from type V dental stone. All dentures were completely waxed using a same thickness of base plate wax and teeth were made for the purpose of accuracy. Following polymerization in the same working conditions, dentures were trimmed. After silicone injection between each denture and metal die was performed, weighing the elastomeric silicone layer was performed to study adaptation of dentures. Metal die was used both before copying the casts and after storing them in water for two months. **Results:** The values for silicone layer weight (in grams) in the group with dental stone type III were greater than the values in type V regardless of the studied period (both after polymerization and after water immersion for a period of two months) in the sample ($p<0.001$). **Conclusion:** The use of high expansion stone (Type V) had improved the adaptation of denture bases.

Key words: Dimensional change, Acrylic denture base, Adaptation accuracy, Dental stones.

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Introduction

Improving adaption of complete dentures will ensure their retention. Denture retention has been defined as ‘resisting vertical movements away from the tissues, the property that keeps a denture base on its base (1). There is a general consensus that exact adaptation is the key to proper retention of complete dentures and to achieve that, the gap between oral tissue and the denture base should be as small as possible (3,2).

The film thickness of saliva induces a physical force that promotes the retention of dentures (4). Therefore, optimal retention occurs when the thickness of existing saliva film between the mucosa and denture surface is thin. This is because the forces required to move the denture are *inversely proportional* with liquid film thickness between the mucosa and denture surface (5, 6).

Sykora pointed out that to improve the adaptation of a denture, dimensional changes during polymerization of Poly Methyl Methacrylates, used in the manufacture of denture bases, must be reduced (7). Although poly Methyl Methacrylate provides dentures with acceptable mechanical properties, it shows dimensional changes to an unavoidable degree. Polymerization, thermal shrinkage and the expansion resulting from water absorption are two factors affecting the adaptation accuracy to a significant degree (8-10).Processing

shrinkage and denture deformation resulting from stress release during manufacturing process, cause movement of teeth and increase the distance between the base and the mucosa beneath, leading to decreased retention (3).

Despite many attempts inusing different polymerization techniques and various acrylic types, deformations still appears when denture is removed from the cast (7,10-13)..

However, it has been found that the coefficient of *linear expansion in type III dental stone (which equals 1/8 of acrylic resin) contributes to stress release and dimensional changes in dentures bases* (11,13,14).

Few researches have been conducted on the influence of the type of dental stone used in fabrication ofcasts on the adaptation of denture bases.In this study we compared adaptation accuracy of complete denture bases in two different types of dental stones used in moulding casts both after polymerization and after water immersion for a period of two months.

Materials and Methods

Sixty maxillary stone casts of two equal groups were studies. One group consisted of 30 casts made from type III dental stone (Durguix, Hard natural stone, Protechno, Spain) and the other 30, of type V dental stone (Gilstone 05, BK GIULINI GmbH, Ludwigshafen/Rh, Germany). The casts were obtained by duplicating a metal die representing an edentulous maxillary arch in a mold made from a silicone elastomer (Vertex Castil 21, Vertex dental, Zeist, The Netherlands). Then, two layers of wax (Tenatex Red, Kamdent, Associated dental products Jtd, UK) were applied on one of the casts and artificial teeth were arranged on it. A silicone elastomer (Vertex Castil 21, Vertex dental, Zeist, The Netherlands) was used to make a negative mold of the wax denture. The original wax denture and cast were removed from the silicone mould. A new set of artificial teeth and a new cast were placed in the mould leaving void where the original wax denture base had been. The cast and mould were held together while molten wax was poured through a hole in the mould. After the wax hardened, the mould was removed, leaving a new wax denture on the cast.

As a result, 60 fully replicated waxed dentures were produced. Heat curing acrylic resin (Vertex Regular, Vertex dental, Zeist, The Netherlands) was used as denture base material. Curing was performed in boiling water for 30 minutes with a denture curing unit (Curing Unit, Teledyne Hanau, Buffalo, N.Y.). After polymerization, the dentures were trimmed.

The adaptation of dentures was studied by weighing the elastomeric silicone layer between each denture and the metal die; also, a second measurement was performed after storing them in water for two months.

Adaptation accuracy study

An additional silicone impression material (Dentkist, Charmflex Light LV, Korea) was used for the study of adaptation accuracy.The silicone was applied using an injection tool which allows an equal distribution of both base and accelerator paste in the denture base. It was spread uniformly over the entire inner surface of the denture base for 30 seconds; the base was then applied on the metal cast. The base was subjected to a 5000 gram load on top of it for five minutes using a metal bulk made of iron. After setting of the silicone completed, the load was removed and the silicone was trimmed using a scalpel to cope the edges of the denture and the metal cast, then the silicone layer was removed from the denture base.

Three silicone layers were recorded for each denture and each layer was weighed on an analytical balance to the nearest 0.0001 g.

The same measurement was conducted after immersion of the dentures in water for two months.

This study took place at the Department of Prosthodontics, Faculty of Dentistry, Damascus University.

Statistical study

The data was analysed statistically using T-Test for independent samples. The significant differences in the average values (in grams) of the silicone layer weights between dentures made from type III dental stone cast and the dentures obtained from type V dental stone casts were studied, and all values were considered significant at $P \leq 0.05$.

Results

Three different silicone layers for each of the acrylic dentures were weighed and the arithmetic mean of the weights was recorded. The arithmetic average of the three layers refers to the accuracy of the denture base adaptation.

The mean values of the silicone layer weight (in grams) in the denture group of type III dental stone (1.89) were greater than those for the denture group of type V (1.26). This was regardless of the period of study (both after polymerization and after water immersion for a period of two months). The difference between values was statistically significant ($P<0.001$), that is less than 0.05 (Table 1).

Table 1. Silicone layer weight values (in grams) according to the type of final dental stone cast used

The Studied Item	Time period	Final cast dental stone type	Mean	Standard deviation	P value
Silicone layer weight (in gram)	after polymerization	Dental stone type III	1.895	0.148	>0.001
		Dental stone type V	1.261	0.091	
	after water immersion for a period of two months	Dental stone type III	1.553	0.128	>0.001
		Dental stone type V	1.125	0.077	

Discussion

Achievement of a denture base highly adapted to the supportive tissues is a key objective in the manufacture of complete dentures. Good denture base adaptation is an important factor in complete denture retention (2, 3, 9, 15, 16). Despite the fact that denture bases made from acrylic resin have many desirable characteristics, the material suffers from shrinking and changes in dimensions appear as the acrylic base moves away from the dental stone cast in complete upper dentures, negatively affecting the adaptation of the denture base and consequently affecting it's retention, as mentioned earlier (12, 13, 15-18).

Earlier studies by Syokara and Sutow (19, 20) on the use of high expansion dental stone to compensate for the acrylic shrinkage have demonstrated 50% reduction in the size of posterior palatal border openings of the maxillary dentures. It should be noted that there is unequal distribution of the forces in denture as these forces are later released unequally in different parts of denture bases. Thus the adaptation should be studied in the whole area of application, not just the posterior palatal area (3,13,21).

In the current study, the method of weighing the elastomeric silicone layer between each denture and the metal die was used to study the adaptation of the whole denture base. Analysis of the data revealed that the maxillary denture bases processed on type V dental stone casts showed a statistically significant difference ($P<0.05$) in terms of denture adaptation, as the silicone layer was lighter in those made on type V dental stone casts (1.26g) compared with denture bases made using a type III dental stone (1.89 g). This was noted regardless of the study period (i.e. both after polymerization and after water immersion for two months).The mean weight of silicon layer in type V stone group (with setting expansion of 0.5%) was lower, leading to better final adaptation than those in type III stone group (with setting expansion of 0.17%).

This can be explained by the fact that high expansion in dental stone V compensates for the thermal and progress shrinkage during manufacture. Thus type V dental stone has an advantage in improving the adaptation of acrylic dentures.

Conclusion

Within the limits of this study, it was concluded that the use of high expansion dental stone (Type V) had a positive effect on improving the adaptation of acrylic denture bases compared with Type III dental stone through compensating for the shrinkage of acrylic resin.

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