DISTORTION OF BASE PLATE DENTURES AS A FUNCTION OF THEIR THICKNESS

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SUMMARY: The misfit of denture bases was evaluated. Three different acrylic resins were employed: heat curing, self-curing and "fluid" resins. The denture bases were measured after their release of the casts and storage in 37°C distilled water during 7 days. Each kind of acrylic resin had a different behavior as related tot its thickness and storage in distilled watter, being the self-curing type that presented the less misfit.

KEY WORDS: Denture base, acrylic resin, dimensional changes.

Dimensional changes of the acrylic resin denture base do occur during its processing and are causes of distortion and lack of its adaptation to the soft tissues, what is mostly evidenced in the posterior part of the palate. Polymerization shrinkage and its partial inhibition by the the stone matrix are the causes of the distortion.

Self-curing acrylic resin molded by the flow of "fluid resin" are said to adapt better than the heat curing one to the stone working model (SHEPARD, 1968); but there are those who think the former distort more during processing than self-curing and heat-curing acrylic resins molded under compression (GOODKING & SCHULTE, 1970; KRAUT, 1971). It has been shown also that the distortion of self-curing fluid resins may be due to the differences in thickness, and that thin base dentures present twice as much shrinkage than the thicker ones (WINKLER *et al.*, 1971a; WINKLER *et al.*, 1971b).

The lack of complete agreement in regard to the influence of the three types of acrylic resins (self-curing and heat curing molded by compression, and self-curing molded by pouring it in a flexible matrix) and thickness on the distortion of denture bases, suggested the present

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study. Its purpose it to observe the effect of several factors on the denture base distortions.

Materials and Methods

One self-curing acrylic resin tray (Clássico, Artigos Odontológicos Clássico) was obtained for the metal model (Fig. 1); the space between the master model and the acrylic resin tray was uniform and its thickness was 2.5 mm.

Stone models, replicas of the metal master model, were obtained with the acrylic resin tray, a polyesther impression material (Impregnum Espe., Western Germany) and stone (BR Produtos Dentários BR) through a conventional technic. Wax base plates (n.º 7, in sheets, Indústria e Comércio de Artigos Dentários) were obtained on the stone models; their lower borders were 5mm far from the lower border of the stone model anterior and lateral walls; the posterior lateral wall of the model was left free. Thickness of the wax base plates were: a) 3.0 mm uniformly thick, b) 1.0 mm uniformly thin, c) thick in the alveolar ridge and thin in palate region and d) thin in the alveolar ridge and thick in the palate region. Reference points for the places where measurements would be performed were marked in 3 points for the micrometer microscope (right and left alveolar ridge for the posterior region and a central point in the posterior region of palate) and in 7 points for the dial gage measurements; these points and the wax base plate thinckness were kept constant in all the wax base plates, through one stone index or matrix, made in three parts, as shown in figure 2.

The wax base plates were invested in stone contained in a flask, for the self-curing and the heat-curing acrylic resins (Clássico, Artigos Odontológicos Clássico) molded under compression; the self-curing "fluid" acrylic resin (Artigos Odontológicos Clássico) was invested in the irreversible hydrocolloid provided with the same.

After the removal of the wax base plate from the investing material and the lining of the later with an insulating material the acrylic resins doughs were molded according to their manufacturer; polymerization was perfomed according to a conventional cycle (TUCKFIELD *et al.*, 1943) for the heat-curing resin at room temperature for the self-curing one and at 50ºC, in humid athmosphere, under a preassure of 22 pounds, in special equipment (Class-Press, Artigos Odontológicos Clássico).

After deflasking the base plate dentures they were just finished, but not polished and the measurements were performed. The spaces between the acrylic resin base plate denture were measured with the equipments already mentioned when it was used the dial gage the metal master model was horizontally located, under it; the first measurement was done with the base plate denture in position and the second of the model alone, without the base plate denture; the space between was then calculated.

With the micrometer microscope, there were measured, directly, the distances from the acrylic resin base plate denture and the model, at the three mentioned points.

Over those experimental factors described (three of resin and thikness of base plate), we have made the measurements in 3 different times: immediately after deflasking the polymerized base plate denture, 7 days after its immersion in distilled water at 37°C, ande before the removal of the base plate from its model.

Those conditions correspond to a factorial design, 3x4x2=24, from which the times of measurements are fictitious, because they were performed in the same denture. We had then 12 different experimental conditions; there were made 10 samples (dentures) for each experimental condition a total of 120 base plate dentures; for three times of measurement we had 360 serie of measurements; and for two different misfit determinations (before and after the water immersion) there were 720 series of measurements of misfit. These determinations were performed for three points of each denture with the micrometer microscope (a total of 720 measurements) and for 7 points of each denture with the dail gage (1680 measurements).

Analysis of variance of the "split-plot" type were performed for the results obtained with the micrometer microscope and with the dial gage; when judged convenient there were calculated the means and critical values of significant factors and interactions.

Results

There will be reported here only the results for micrometer microscope because are similar to those for the dial gage.

The analysis of variance for the micrometer microscope values indicated that in regard to the base plate dentures misfit the materials used behaved differently, but not their thickness; the points where the measurements were performed did present different misfits; the phases of measurements did present different results; and several interactions were statistically different. Table 1 presents the misfit means for each level of the principal factors studied, as well as the critical value for those with more than two levels. It is seen that self-curing acrylic resin presented smaller misfits than the heat-curing and the "fluid resin" ones. The different thickness did present diverse misfits, althoug it is seen that the dentures with uniform 3.0mm thickness did present less misfit than the other thickness. In regard to the points or regions of measurements, it is clear that the misfit is not uniform, but different in these points which means that the denture suffers an overall distortion as a consequence of the partially inhibited polymerization dimensional changes; this is due to the induced stress and the later posliberation. As it should be expected the water immersion, time (7 day storing) and temperature (37°C) did contribute to a greater distortion and misfit of the dentures, as shown in the last line of table 1.

We could find a statistically significant interation between acrylic resin types and base plate dentures thickness, with a criticall value of 27.5, significant at the 5% level. It confirms the observed fact that the self-curing acrylic resin does present less general distortion than the heat-cured one and that the self-curing "fluid" resin; heterogeneous thickness tend to cause greater misfits than homogeneous one. Uniformly thin (1.0 mm) acrylic resin dentures tended to present the greatest misfit.

A significant interaction was also found between acrylic resin types and regions of measurements (critical value was 13.4 at 5% level of significancy). The important observation is

TABLE 1 — Average misfits (um of the base plate dentures, as a function of acrylic resin type, thickness, regions of measurement, time of measurement, and critical value for differences between each two means.

Acrylic Resin			Tukey
heat-curing	self-curing "Fluid"	self-curing	(5%)
70	46	69	9,8*

Denture thickness				
Uniform		Heterogenous		
1.0mm	3.0mm	Palatine vault = 1.0mm Flanges = 3.0mm	Palatine vault = 3.mm Flanges = 1.mm	
64	55	67	60	N.S.**

Regions of measurement			
right posterior	posterior of palate	left posterior	
56	62	67	5,8*

Time of measurement		
Before immersion in water	after 7 days immersion in 37°C water	
59	64	S

* — statistically significant,
** — not significant

that the self-curing base plate dentures presented similar misfits in the three different regions of measurements, while heat-curing and "fluid-resin" presented different values for those regions meaning that the later two distorted more than the former.

The interaction between base denture thickness and regions of measurement confirms that the uniformly thicker (3.0mm) dentures distorted less and presented smaller misfits than the uniformly thin and the heterogeneous base plate dentures (1% significant critical value = 16.3)

Average misfits for the interaction between resins and time of measurements confirms once more that storage, temperature (37°C) and water immersion increase the misfists; however, the misfits due to them only occurred for heat-cured and "fluid" resins.

Average misfits for the interaction between base plate denture thickness and time shown that uniformly 3.0 mm thick denture tends to present smaller misfit than the uniformly 1.0 mm thick and the heterogeoulsy thick ones, as a consequence of storage in 37°C water (1% significant critical value = 7.8).

The data obtained with the dial gage, when statistically evaluated through an analysis of variance, presented results similar to those obtained with the micrometer microscope. A statistical comparison between the results obtained with these instruments showed that the micrometer microscope made it possible to obtain results numerically greater than those found with the dial gage; this may mean a greater possibility of finding differences between two means when using the micrometer microscope to read the distance between the points of measurement.

Discussion

Our results confirm in a general pattern what is generally known in regard to the base plate denture, as pointed by previous researchers (GOODKING & SCHULTE, 1970; KRAUT, 1971; WINKLER *et al.*, 1971; WOELFEL *et al.*, 1959; WOELFEL *et al.*, 1961; WOELFEL *et al.*, 1962, WOELFEL *et al.*, 1965).

Under the practical standpoint it is interesting to stress that there is a general tendency for the base plate acrylic resin dentures to present an heterogeneous misfit, in regard to its model; this heterogeneous misfit is consequent to dimensional changes that the acrylic resin suffers during the dental laboratory polymerization process. The higher the dimmensional changes, the higher the induced stresses and thus the greater the distortion and misfit between the denture and its master model; it is for this reason that the "self-curing' acrylic resin, which dimensional change is smaller than that of the heat-curing one (WOELFEL *et al.*, 1959; WOELFEL *et al.*, 1960; WOELFEL *et al.*, 1961; WOELFEL *et al.*, 1962; WOELFEL *et al.*, 1965) presents less misfit than the later.

For this reason it was a surprise to see that the "fluid" resin presented greater misfit than the "self-curing" one, which is possibly due to a composition factor and also to its particular processing technic; this result do agree, however, with previous statements (GOODKING & SCHULTE, 1970; KRAUT, 1971).

Thin base plate dentures tend to present greater distortions and thus greater misfit, as already stressed in the literature (HARMAN, 1949).

During the acrylic resins denture bases processing there are induced stresses, which are difficult to release, due to the strenght of the solid cured acrylic resin; it is for this reason that those factors which make easier the stress release (storage, water immersion, high temperature) tend to increase distortion and misfit.

These observations and the interactions between the level of the factors studied are of use to those which process and provide base plate dentures to patients, and are helpfull to interpret the changes observed in their processing.

Summary and Conclusions

Base plate dentures were processed using three different types of acrylic resins: heat-curing, self-curing, and "fluid" self-curing ones. These dentures were obtained in four thickness, which were different in the following way: uniformly thick (3.0mm) or thin (1.0mm), heterogeneously thick (3.0 mm in the palatine vault and 1.0mm in the flanges, or 1.0mm in the palatine vault and 3.0mm in the flanges). These dentures were processed according to the respective acrylic resins manufacturers. After processing and deflasking they were measured in determined points of each denture, to evaluate the misfit between them and the respective model, after their release of the correspondent models and after storage of the data obtained made it possible to arrive to the following conclusions: 1) the three types of acrylic resins behaved differently in regard to the observed misfit, the self-curing type presenting smaller misfits than the heat-curing and the "fluid resin" ones; 2) there was a tendency for the uniformly thick (3.0mm) dentures to present smaler misfit than the uniformly thin (1.0mm) and the heterogenously thick ones; 3) the observed misfit was not equal in the various regions where it was measured; it was greater in the posterior regions of the denture and smaller in the anterior region; this difference does correspond to a general distortion of the denture; 4) the misfits observed tends to increase with the seven days storage of the dentures in 37°C distilled water and a statistically significant difference was found for the data obtained with micrometer microscope and dial gage, the former presenting larger misfit results than the later.

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Foram confeccionadas bases de dentaduras usando três tipos diferentes de resinas acrílicas: de ativação térmica, de ativação química, e de ativação química "fluida". Estas dentaduras foram obtidas em quatro espessuras diferentes: espessura uniforme (3mm) ou fina (1mm), espessura heterogênea (3mm no palato e 1mm nos rebordos, ou 1mm no palato e 3mm nos rebordos). Estas dentaduras foram obtidas de acordo com as instruções dos fabricantes. Após a polimerização e desmoldagem elas foram medidas em pontos determinados, para avaliar o desajuste entre elas e o respectivo modelo, após a sua separação do modelo e após a imersão em água destilada a 37°C por 7 dias. A avaliação estatística dos dados obtidos possibilitaram concluir que: 1) os três tipos de resinas acrílicas se comportam diferentemente em relação ao desajuste, o tipo ativado quimicamente apresentou menores desajustes do que os tipos ativado termicamente e ativado quimicamente "fluido"; 2) houve uma tendência para um desajuste menor nas dentaduras uniformemente espessas (3mm) em relação a uniformemente fina (1mm) e as de espessuras heterogêneas; 3) o desajuste observado não é igual nas várias regiões medidas; é maior na região posterior e menor na região anterior; estas diferenças correspondem a uma distorção geral das dentaduras; 4) os desajustes observados tendem a aumentar após a imersão em água destilada a 37°C durante 7 dias; 5) foi constatada diferença estatística significante entre os dados de desajustes obtidos com o relógio micrométrico e o microscópico comparador, sendo maiores as medidas de desajuste neste último.

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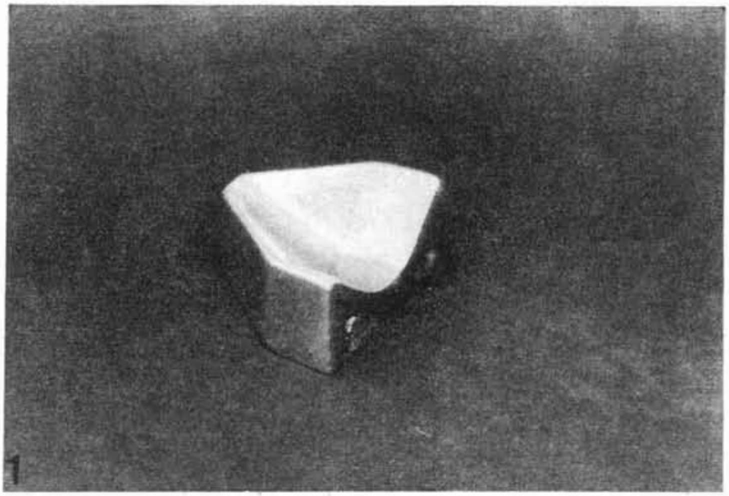
LEGENDS

Fig. 1. Stainless steel master model

Fig. 2. Stone index to control thickness of wax base plate dentures and to determine the points for misfit measurements.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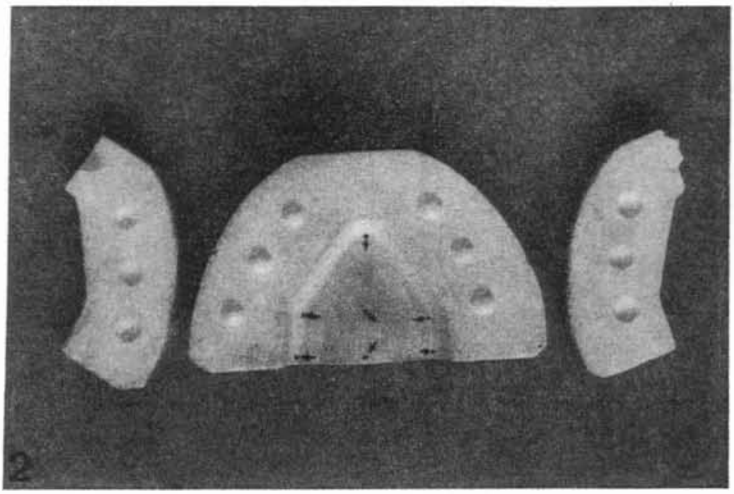
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