Braz Dent J (2002) 13(1): 57-60 ISSN 0103-6440

Effect of Commercial Acrylic Resins on Dimensional Accuracy of the Maxillary Denture Base

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Denture base dimensional changes were found with commercial thermocured acrylic resins. Fifteen stone cast-wax base sets were packed for routine flasking. Clássico, Vipcril, and Meliodent Multicryl acrylic resins were prepared according to manufacturer instructions. After final acrylic resin pressing, the flasks were placed in strain clamps and submitted to polymerization cycles in heat-water following manufacturer instructions. The resin bases were fixed on casts with instant adhesive and the sets laterally sectioned in the corresponding regions to the distal of canines (A), mesial of first molars (B), and posterior palatal zone (C). The gap between the stone cast and resin base was verified with a measuring microscope at five reference positions for each type of cut. The data were submitted to ANOVA and Tukey's test and a significant statistical difference between the commercial acrylic resins was shown. The pattern of distortion verified in the posterior palatal region was confirmed in the C cut with significant statistical differences among the three acrylic resins. However, there were no significant statistical differences in A and B cuts.

Key Words: denture base, acrylic resin, adaptation level.

INTRODUCTION

The dimensional changes of the denture base result from both polymerization shrinkage and stresses released during flask cooling. Conversely, the variations in curing technique may not significantly alter the pattern of dimensional acrylic resin behavior due to the decrease in the molecular weight of the resulting polymer chains (1,2).

The magnitude of the acrylic resin dimensional changes, however, may be influenced by several factors, such as polymerization techniques, where the internal stresses are produced by different coefficients of thermal expansion of gypsum and acrylic resin (3), and the base thickness may vary at different sites inside the flask (4,5), altering the denture base adaptation and stability (6).

Thus, although acrylic resin is the most commonly used material in dental construction it is subject to polymerization shrinkage and distortion. The shrinkage resulting from the polymerization reaction is not uniform, being more evident on the palate of the maxillary denture and will be poorly compensated after resin base processing (5). Conversely, the distortion resulting from flask cooling and stone cast deflasking induce stresses released during the base procedure (7). Consequently, the combination of polymerization shrinkage and strain release decreases the adaptation level of support tissue, influencing the base stability (8).

With the object of reducing the variables that alter base stability, several processing techniques have been suggested as alternatives to the conventional heat-water bath. Some studies, however, demonstrated that the base adaptation to the stone cast is unsatisfactory (9), as it is influenced by the base thickness (10), palate geometry (11), and processing methods (12), without being influenced by different curing cycles (13).

Although the dental position modified by linear changes may be easily corrected by occlusal adjustment, the palatal posterior region, considered to be a

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critical area in relation to base retention, will be hardly corrected after processing (5). The contraction which occurs during polymerization is not uniform, and is also influenced by the base thickness (5), being more evident in the posterior palatal region (14) whilst the distortion occurs during cooling or after the base is separated from the cast (7). Besides the factors inherent to the physical properties of acrylic resin, technical procedures and the anatomical conditions of the patient's mouth have been demonstrated previously in the literature, and it would be desirable to verify the effect of commercial acrylic resins on denture base adaptation. Thus, the purpose of this study was to verify the dimensional changes of denture bases processed with three commercial heat-cured acrylic resins.

MATERIAL AND METHODS

Five specimens were made for each of 3 heat-cured acrylic resins: Clássico (Clássico Dental Products, São Paulo, SP, Brazil), Vipcril (Dental Vipi Co., Pirassununga, SP, Brazil) and Meliodent Multicryl (Heraeus-Kulzer GmbH, Wehrheim, Germany). The main composition of the acrylic resins is: Clássico - the powder consists of prepolymerized spheres of polymethylmethacrylate and benzoyl peroxide as an initiator, and the liquid is an unpolymerized copolymer of methylmethacrylate and ethylacrylate; Vipcril - the powder is a copolymer of ethylmethylmethacrylate, acrylates and benzoyl peroxide, and the liquid consists of copolymer of methacrylates; Meliodent Multicryl - the powder is a polymethylmethacrylate, and the liquid is a methylmethacrylate, dimethacrylate and benzoyl peroxide.

A metal master die was prepared from a mould to simulate a maxillary arch without irregularities in the alveolar ridge crest with Elite Double silicone (Zhermack, Rovigo, Italy). Fifteen casts were prepared with Herodent Soli-Rock class III dental stone (Vigodent, Rio de Janeiro, RJ, Brazil) using a ratio of 100 g of powder to 30 ml of water, according to manufacturer instructions. A wax denture baseplate with a thickness of 2 mm was made on the respective casts and the sets were embedded in flasks with dental stone according to the conventional flasking procedure.

After 1 h, the flasks were placed in boiling water for 10 min to soften the wax baseplate. The flasks were then separated, the wax removed and the stone cleaned with liquid detergent and boiling water. One coat of sodium alginate (Clássico Dental Products) was used as a mould separator.

The acrylic resins were used with a polymer:monomer ratio of 3:1 by volume and the plastic dough was packed in the flasks under a final packing pressure of 1250 kgf. Afterwards, the flasks were placed in strain clamps and the acrylic resins were submitted to the curing cycles following manufacturer instructions: Clássico - water bath heated at 74ºC for 9 h; Vipcril - flask immersion in water at 75ºC for 1 h, followed by 1 h at 95ºC; Meliodent Multicryl - flask immersion in water at 45ºC for 20 min, followed by 10 min at 70ºC and boiling water for 20 min. After flask cooling at room temperature the bases were deflasked, trimmed and fixed on their corresponding casts with instant adhesive (Super Bonder, Loctite) to avoid base displacement during the cutting procedure.

The base-cast sets were transversally sectioned into three portions corresponding to the distal of canines (A), mesial of first molars (B), and posterior palatal zone (C). In each section the base-cast discrepancies were measured at five locations: right and left ridge crests, posterior palatine midline, and right and left marginal limits using an optical comparator microscope (Leitz, Germany) with a traveling stage calibrated to 0.001 mm.

Three measurements were made at each location and the mean values were calculated. A total of 675 individual measurements were made on the 15 base-cast sets and the data were submitted to ANOVA and Tukey's test with a significance level of 5%.

RESULTS

The means of dimensional changes verified in the bases revealed the influence of the commercial acrylic resins in the denture base adaptation. A statistically significant difference ($p<0.05$) was noted between the Vipcril (0.254 mm ± 0.093) and Clássico (0.225 mm ± 0.610) acrylic resins, whilst Meliodent Multicryl presented results with statistical similarity (0.238 mm ± 0.074) to those obtained for both Vipcril and Clássico. Small values of discrepancies were shown in the Clássico acrylic resin base.

When the cut factor was analyzed (Table 1) the results demonstrated no statistically significant difference between A and B sections of the bases made with

Table 1. Means ± SD of base discrepancy (mm) for each resin, in relation to cut factor.

Resin	Cut		
	A	B	C
Vipcril	0.166 ± 0.046[a]	0.226 ± 0.010[a]	0.371 ± 0.028[a]
Meliodent	0.162 ± 0.121[a]	0.220 ± 0.079[a]	0.332 ± 0.013[b]
Clássico	0.156 ± 0.005[a]	0.229 ± 0.041[a]	0.290 ± 0.011[c]

Means followed by different letters in columns are statistically different (5%).

Table 2. Means ± SD of base discrepancy (mm) among cuts, in relation to resin factor.

Cut	Resin		
	Clássico	Vipcril	Meliodent
A	0.156 ± 0.005[a]	0.166 ± 0.046[a]	0.162 ± 0.121[a]
B	0.229 ± 0.041[b]	0.226 ± 0.010[b]	0.220 ± 0.079[b]
C	0.290 ± 0.011[c]	0.371 ± 0.028[c]	0.332 ± 0.013[c]

Means followed by different letters in columns are statistically different (5%).

the commercial acrylic resins. However, the discrepancies produced between the acrylic resins in the C section were statistically significant.

Conversely, the adaptation changes which occurred between sections related to the acrylic resin factor were statistically significant, a small discrepancy was shown in cut A, and a larger one in cut C, whilst cut B had an intermediate value (Table 2).

DISCUSSION

The adaptation level of the denture base was influenced by commercial acrylic resins. This influence was more evident when the comparison was made between the Vipcril and Clássico products, which were statistically different. A small discrepancy value was obtained for the Clássico acrylic resin. Although the discrepancy values produced by the Meliodent Multcryl acrylic resin were statistically similar to those of the Vipcril and Clássico resins, it was evident that the commercial products highly influenced the dimensional stability of the acrylic resin bases.

Although several other variables may influence the magnitude of the dimensional changes occurring in the denture base (5), such as the difference in the base thickness between marginal and central zones, and polymerization time (4), the association of all of these factors may certainly modify the adaptation level of the denture base to support tissues (8). Conversely, the resilience of the gingival mucosa, even when reasonable conditions of adaptation were demonstrated, did not compensate discrepancies beyond 1 mm when they occurred in the central portion of the posterior palatal region (15).

When the cut factor was analyzed (Table 1), the same discrepancy level was verified in sections A and B, with no statistical differences between acrylic resins. Conversely, the discrepancies promoted in section C were statistically significant between the commercial products.

The discrepancy pattern demonstrated in this study confirmed that the dimensional changes suffer the influence of the commercial acrylic resins and are also dependent on other factors, such as base thickness (16), different locations of the base (14) and palatal geometry (11), which promote critical effects in the magnitude and localization of the distortion, mainly occurring in the posterior palatal region.

The tendency to promote discrepancy of different magnitudes in relation to base location can be understood when one considers that section A is located in a restrictive topographic area resulting from cast anatomy (17) which impedes resin expansion (18). In addition, the topographic form of the anterior arch limits the stresses released after mould separation. The posterior palatal region is flatter and less restrictive and permits strain release, producing more evident distortion in this region (3).

The distortion pattern demonstrated less discrepancy in cut A and more alteration in cut C, whilst cut B had intermediary values; all were statistically significantly different in relation to the material factor (Table 2). This occurrence was due to the restriction caused by cast anatomy (17), which impeded the tension release in the anterior region which is considered to be the more restrictive zone and permits its release in the posterior palatal region, considered to be the less restrictive zone (3).

Therefore, the distortion pattern of the base obtained in this study agrees with those of previous investigations (3,15,19,20) also showing the complexity of the procedure which involves diverse and different factors.

RESUMO

Consani RLX, Domitti SS, Rizzatti Barbosa CM, Consani S. Efeito das resinas acrílicas comerciais sobre a precisão dimensional da base de prótese total superior. Braz Dent J 2002;13(1):57-60.

A alteração dimensional da base de prótese total foi verificada em função de tipos comerciais de resina acrílica. Quinze conjuntos base de cera-modelo de gesso foram incluídos em muflas metálicas pela técnica de rotina. Após prensagem final das resinas acrílicas Clássico, Vipcril e Meliodent Multicryl, as bases foram polimerizadas em banho de água aquecida, de acordo com as recomendações dos fabricantes. Os conjuntos base de resina-modelo de gesso foram cortados em três secções laterais correspondentes à distal dos caninos (A), mesial dos primeiros molares (B) e região palatina posterior (C). A fenda entre base de resina e modelo de gesso foi analisada em cinco pontos referenciais para cada secção com microscópio comparador Leitz, com precisão de 0,001 mm. Os resultados submetidos à análise de variância e ao teste de Tukey mostraram diferença estatística significante entre os produtos comerciais. O padrão de distorção verificado na região palatina posterior da base foi confirmado no corte C, com diferença estatística significativa nos três tipos de resina. Entretanto, não houve diferença estatística significante nos cortes A e B dentro do fator resina.

Unitermos: prótese total, resina acrílica, nível de adaptação.

REFERENCES

1. Harman IM. Effects of time and temperature on polymerization of a methacrylate resin denture base. J Am Dent Assoc 1949;38:188-203.
2. Anusavise KJ. Phillips' Science of Dental Materials. 10th ed. Philadelphia: WB Saunders; 1996.
3. Woelfel JB, Paffenbarger GC, Sweeney WT. Clinical evaluation of complete dentures made of 11 different types of denture base materials. J Am Dent Assoc 1965;70:1170-1188.
4. Wolfaardt J, Cleaton-Jones P, Fatti P. The influence of processing variables on dimensional changes of heat-cured poly(methyl methacrylate). J Prosthet Dent 1986;55:518-525.
5. Chen JC, Lacefield WR, Castleberry DJ. Effect of denture thickness and curing cycle on the dimensional stability of acrylic resin denture bases. Dent Mat 1988;4:20-24.
6. Jackson AD, Grisius RJ, Fenster RK, Lang BR. Dimensional accuracy of two denture base processing methods. Int J Prosthod 1989;2:421-428.
7. Mathews E. Residual problems in full denture prosthesis. Br Dent J 1954;97:167-177.
8. Takamata T, Setcos J, Phillips R, Boone ME. Adaptation of acrylic resin dentures as influenced by the activation mode of polymerization. J Am Dent Assoc 1989;119:271-276.
9. Jackson AD, Lang BR, Wang RF. The influence of teeth on the denture base processing accuracy. Int J Prosthod 1993;6:333-340.
10. Sadamori S, Ganefiyanti T, Hamada T, Arima T. Influence of thickness and location on the residual monomer content of denture base cured by three processing methods. J Prosthet Dent 1994;72:19-22.
11. Sykora O, Sutow EJ. Posterior palatal seal adaptation: influence of processing technique, palate shape and immersion. J Oral Rehabil 1993;20:19-31.
12. Wong DMS, Cheng LYY, Chow TW, Clark RKF. Effect of processing method on the dimensional accuracy and water sorption of acrylic resin dentures. J Prosthet Dent 1999;81:300-304.
13. Turk MD, Lang BR, Wilcox DE, Meiers JC. Direct measurement of dimensional accuracy with three denture-processing techniques. Int J Prosthod 1992;5:367-372.
14. Latta GL, Bowles WF, Conkin JE. Three dimensional stability of new denture base resin in the mold processing. J Prosthet Dent 1990;63:654-661.
15. Polyzois GL. Improving the adaptation of denture base by anchorage to the custs: a comparative study. Quint Int 1990;21:185-190.
16. van Straten RJ, Hitge ML, Kalk W, Schenk J. A study of acrylic resin denture base material distortion using computer-aided holographic interferometry. Int J Prosthod 1991;4:577-585.
17. Sweeney WT, Paffenberger GC, Beall JR. Acrylic resins for dentures. J Am Dent Assoc 1942;29:7-33.
18. Kawara M, Komiyama O, Kimoto S, Kobayashi K. Distortion behavior of heat-activated acrylic denture-base resin in conventional and long, low-temperature processing methods. J Dent Res 1998;77:1446-1453.
19. Anthony DH, Peyton FA. Dimensional accuracy of various denture-base materials. J Prosthet Dent 1962;12:67-81.
20. Sanders JL. Comparison of adaptation of acrylic resin cured by microwave energy and conventional water bath. Quint Int 1991;22:181-186.

Accepted November 14, 2001