# RESIDUAL MONOMER OF HEAT CURED ACRYLIC RESIN IN FUNCTION OF THE INVESTING MATERIAL

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BOMBONATTI, P. E., BARROS, L. E., SCARANELO, R. M. & SOUZA, V. — Residual monomer of heat cured acrylic resin in function of the investing material. **Rev. Odont. UNESP**, 8/9:91-95, 1979/1980.

SUMMARY: The residual monomer was quantified in heat cured resin polimerized in a flask containing plaster and a layer of silicone rubber, and in resin polimerized by the conventional technique. No difference was observed in the quantity of residual monomer.

KEY WORDS: Heat cured resin, silicone liner, residual monomer.

Since the advent of silicone rubbers that set at room temperature it is possible to process complete dentures in flexible molds, as these products dispense with the use of tin foil substitute during the polimerization. MARCROFT *et al* (1961) pointed out that the acrylic resin surface cured in that mold needs less polishing and presents good details reproducibility and BIESKE (1972) obtained plaster-free acrylic resin surfaces. Another advantage is, according to MOLNAR *et al.* (1968) the elimination of porosity of the heat cured acrylic resin even when submitted to different conditions from those normally found during the curing process. TUCKER & FREEMAN (1971), UETI & MUENCH (1974), and ZAKHARI (1976), verified the influence of this silicone layer on the dimensional changes of resins, while REISBICK (1972) and BOMBONATTI (1978) studied its influence on the denture fitting and ZANI (1974), MUENCH & UETI (1974) and BECKER *et al.* (1977), tested its behavior in relation to artificial teeth movements.

An interesting point that must be remembered when talking about resins refers to the residual monomer that,

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according to CAUL *et al.* (1956), CORNELL & POWERS (1959) and SMITH (1961) interferes in its properties. As it is not known the influence of the silicone mold liner on the quantity of residual monomer of the heat cured acrylic resin, the aim of this paper is to get this information, comparing this kind of denture investing to the standard one.

## Material and Method

Only one brand of heat cured acrylic resin was used in this investigation (Classico, Artigos Odontológicos Clássicos Ltda., São Paulo, Brasil). The specimens, in number of ten, were obtained starting from disks of wax pattern, measuring 38.1 millimeters in diameter by 3.4 millimeters in thickness. The specimens were invested in stone poured in the lower part of the flask, being two disks in each flask. After setting, the stone was lubricated with petrolatum and a layer of silicone rubber (Flexistone, Molloplast KG-Kostner & Co, Oberursel/Taunus, West Germany) approximately 2 millimeters thick was applied over one specimen. After the silicone had set, the upper part of the flask was filled up with stone. The wax was eliminated from the flasks with boiling water, and a liquid separating medium (Cel-Lac, S.S. White Artigos Dentários, Rio de Janeiro, Brasil) wax applied on the stone but not on the silicone. The curing process was started raising the temperature up to 65°C for 90 minutes, then raised up to 100°C for 60 minutes. A low cooling down process was employed till reach the room temperature in all series.

The determination of the residual monomer was made by using 0.2 g of the central part of each specimen and employing the technique preconized by SMITH & BAINS (1956) which consists of halogenation by bromine and the titration of the liberated iodine with 0.01N sodium thiosulphate solution. The data interpretation was made by applying the analysis of variance according to SCHEFFÉ (1959).

## Results

The results concerned with the quantity of residual monomer observed in the specimens of heat curing acrylic resin obtained from molds lined with silicone rubber and from stone molds lubricated with a liquid separating medium are seen on the table 1.

The comparison through the analysis of variance applied to the results seen on the table 1, shows there is no significant difference between both techniques of flasking.

## Discussion

GARLIPP *et al.* (1967) consider the impermeability as the most desired property of a separating medium. When a separating medium is permeable there is a great possibility of fluid changes, with the passage of water from the stone to the resin and monomer from the resin to the stone. Also, according to these authors, the more impermeable the separating medium, the more monomer is retained by the acrylic mixture, and more effective will be its contribution to the final work, either as a polymer or as a residual monomer. Little has been reported about the permeability of the silicone employed as separating medium, mainly in relation to Flexistone, a product described at first by KELLER (1968).

TABLE 1

Quantity of residual monomer (percentage) observed in resins made in both types of investing materials.

| | Types of Flasking | |
|---|---|---|
| Specimens | Silicone | Stone |
| 1 | 0.20 | 0.15 |
| 2 | 0.25 | 0.30 |
| 3 | 0.10 | 0.10 |
| 4 | 0.25 | 0.25 |
| 5 | 0.10 | 0.25 |

According to the results obtained in this work, the behavior of both types of separating medium is the same in relation to the quantity of residual monomer. Starting from this point, we can also figure it out they are equal as far as the permeability is concerned. On the contrary, HARCOURT *et al.* (1969) have shown that porosity can be avoided when a layer of silicone, 1 to 2 millimeters thick, is applied to form the mold and the curing process is developed faster and more severe than that normally used. The porosity can be prevented either by controlling the rate of heating or by the pressure during polimerization, even if under the most severe conditions of heating that enable a temperature above the boiling temperature of the methyl methacrylate monomer to be developed inside the flask. Analysed under this point of view, the technique employing a layer of silicone would be better than the standard one that employes stone as a mold, mainly as far as porosity is concerned. Our results agree with those of TUCKER & FREEMAN (1971), ZANI (1974), MUENCH & UETI (1974), BECKER *et al.* (1977) and BOMBONATTI (1978), that did not find the silicone lining better than stone matrix, when studying other properties of the acrylic resin.

## Summary and Conclusions

The quantity of residual monomer existing in a heat cured acrylic resin denture base was determined by comparing the convencional way of flasking with plaster to the technique employing a layer of silicone rubber, approximately 1 to 2 millimeters thick.

Ten specimens were made, 5 in each technique and the quantity of residual monomer was evaluated by the halogenation by bromine and the titration of the liberated iodine with 0.01N sodium thiosulphate solution.

The data obtained let us conclude that there is no significant difference in the quantity of residual monomer in the techniques compared.

BOMBONATTI, P. E., BARROS, L. E., SCARANELO, R. M. & SOUZA, V. — Quantidade de monômero residual em resina acrílica ativada termicamente em função do material de inclusão. **Rev. Odont. UNESP, 8/9**:91-95, 1979/1980.

RESUMO: Determinou-se a quantidade de monômero residual existente em uma resina acrílica para base de dentadura ativada termicamente, fazendo um estudo comparativo entre as técnicas de inclusão convencional, com uma muralha de gesso, e a técnica de inclusão que emprega o forramento do molde com uma camada de silicona com aproximadamente 2 milímetros de espessura.

Foram construídos 10 corpos de prova, 5 para cada técnica, sendo a quantidade de monômero residual determinada empregando-se o método de halogenação pelo bromo e titulação do iodo liberado com uma solução 0,01N de tiossulfato de sódio.

Os resultados permitiram concluir que não há diferença significante na quantidade de monômero residual existente nas resinas obtidas com as duas técnicas de inclusão estudadas.

## REFERENCES

BECKER, C.M., SMITH, D.E. & NICHOLLS, J. I. 1977. The comparison of denture-base processing techniques. Part II. Dimensional changes due to processing. *J. prosth. Dent.*, 37:450-459.

BIESKE, R. H. 1977. Obraz mikroskopowy powierzchni spolimeryzowanego akrylu przy stosowaniu izolacji silikonowej. *Protet. Stomatol.*, 22:227-231.

BOMBONATTI, P. E. 1978. *Influência dos métodos de isolamento, dos tipos de resinas e das diferentes temperaturas de abertura da mufla após a polimerização sobre a adaptação de uma base de dentadura.* Tese Livre Doc. Fac. Odont. Araçatuba, São Paulo, Brasil.

CAUL, H.J., SWEENEY, W.T. & PAFFENBARGER, G. C. 1956. Relationship between residual monomer and some properties of self-curing dental resins. *J. Amer. dent. Ass.*, 53:60-63.

CORNELL, J.A. & POWERS. C.M. 1959. The effect of varying peroxide and polymer on the rate and degree of polimerization of polymethyl methacrylate slurries. *J. dent. Res.*, 38:606-610.

GARLIPP,O.A., BOMBONATTI, P.E. & BARROS, L.E. 1967. Influência dos isolamentos sobre a massa molecular das resinas acrílicas. *Rev. Farm. Odont.*, 320:69-73.

HARCOURT, J. K., LAUTENSCHLAGER, E.P. & MOLNAR, E.J. 1969. Elastomeric mold liners in the production of porosity-free polymethyl methacrylate. *J. dent. Res.*, 48: 61-66.

KELLER. F. 1968. Flexistone - die esoliierende modellmasse. *Die Zahntechnik.* 26:30-32.

MARCROFT, K.R., TENCATE, R.L. & HURST, W. W. 1961. Use of a layered silicone rubber mold technique for denture processing. *J. prosth. Dent.*, 11:657-664.

MOLNAR, E.J., GRUBER, R.G. & SAWYER, N. 1968. Internal porosity in heat-cured methyl methacrylate resin for dental use. *J. dent. Res.*, 47:665 (Abst).

MUENCH, A. & UETI, M. 1974. Alterações das posições dos dentes em em uma prótese total, em função do material de inclusão. *Rev. Fac. Odont. São Paulo,* 12:131-138.

REISBICK, M. H. 1972. Silicone as a denture mold liner. *J. prosth. Dent.,* 26:382-386.

SCHEFFÉ, H. 1959. The analysis of variance. New York, John Wiley & Sons.

SMITH, D. C. 1961. The acrylic denture base. *Brit. dent. J.,* **111**:9-17.

SMITH, D. C. & BAINS, M.E.D. 1956. The detection and estimation of residual monomer in polymethyl methacrylate. *J. dent. Res.,* 35:16-24.

TUCKER, K.M. & FREEMAN, B.J. 1971 The effect of investing material on processing changes in complete dentures. *J. prosth. Dent.,* 25:206-216.

UETI, M. & MUENCH, A. 1974. Alterações dimensionais da resina acrílica em molde de gesso e aliviado com silicona. *Rev. Fac. Odont São Paulo,* 12:229-234.

ZAKHARI, K. N. 1976 Relationship of investing medium to oclusal changes and vertical opening during denture construction. *J. prosth. Dent.,* 36:501-509.

ZANI, D. 1974. *Influência do agente de isolamento do gesso (folha de estanho, alginato ou siliconas) sobre: a posição relativa dos dentes de uma base de dentadura de resina acrílica e a rugosidade desta última.* Tese Liv. Doc. Fac. Odont. Florianópolis, Santa Catarina, Brasil.

Recebido para publicação em 20-09-79.