

USE OF HYPERBRANCHED POLYMER IN DENTAL RESINS TO REDUCE POLYMERIZATION SHRINKAGE

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INTRODUCTION: Linear polymers (BisGMA, TEGDMA, etc.) have been commonly used in the matrix of composites. Recently, new types of polymers, hyperbranched polymers (HBP), have been synthesized. HBP are very large molecules with many branches and a large number of functional groups on each molecule in comparison with traditional linear polymers. In a previous study [1], a linear relationship was found between the volume contraction and the actual number of double bonds converted. A reduction of the polymerization shrinkage may obviously be expected from the addition of molecules allowing the double bond conversion per unit of volume of resin matrix to be decreased. HBP are thus attractive because their functionalities can be modified to obtain molecules with a high volume and few double bonds. The objective of this study was to investigate the potential of HBP to decrease polymerization shrinkage of the composite matrix while maintaining double bond conversion.

METHODS: The resins investigated consisted of a conventional mixture, BisGMA/TEGDMA (50/50 wt/wt), used as a reference, in which three HBPs, with different shell chemistry, were added at several weight ratios (5, 10, 20, 30, and 40%). A photoinitiation system was added to each mixture in a proportion of 1%. Degree of conversion (DC) of the polymers was determined by Raman spectroscopy. The volume contraction was measured by pycnometry and by a density column.

RESULTS:

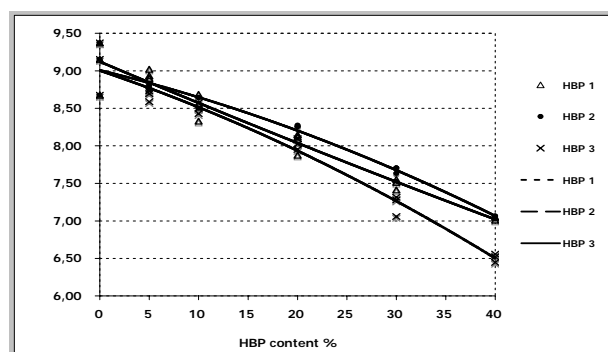


Fig. 1: Polymerization contraction of the resins as a function of the HBP content

Fig. 1 shows that polymerization shrinkage decreases when an increasing weight of HBP is

added to the BisGMA/TEGDMA 50/50 mixture. The lowest volume shrinkage achieved was about 6.5%, which is approximately 30% less than the reference

(9%). The most pronounced effect on shrinkage reduction was achieved when HBP3 was added.

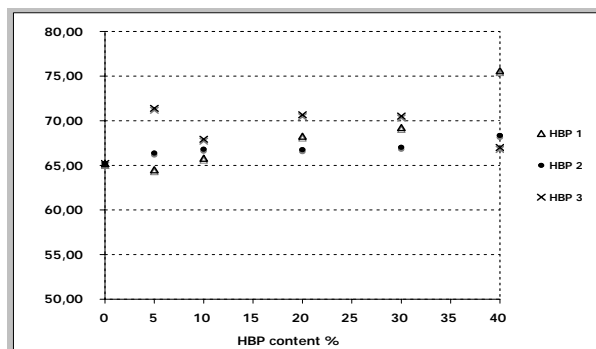


Fig. 2: Degree of conversion of the resins versus HBP content.

The DC for the BisGMA/TEGDMA (50/50), used as the reference, was not significantly different from that of any of the modified systems, as shown in Fig. 2.

DISCUSSION & CONCLUSIONS: By decreasing the volume shrinkage and maintaining the DC, the modified resins are likely to give an improved organic matrix in comparison with the commonly used BisGMA/TEGDMA matrix. However, mechanical properties and viscosity should not be affected by the presence of HBPs. Increased viscosity would have several negative effects on the manufacture or application of dental composites. In a recent study [2], the addition of HBP to a mixture of BisGMA/TEGDMA (1:1) resulted in improved mechanical properties without increasing the viscosity. Work along this line is in progress.

REFERENCES: ¹ M. Dewaele, D. Truffier-Boutry, J. Devaux, G. Leloup (2006) *Volume contraction in photocured dental resins: the shrinkage-conversion relationship revisited*. *Dent Mat* **22**:359-65. ² Q. Wan, SR. Schricker, BM. Culbertson (2000) *Hyperbranched multi-methacrylates; their application in dental resins systems*. *Polym Prepr* **41**: 155-6.

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