

Effect of pH and storage time on the elution of residual monomers from polymerized composites

Cheol-Min Jeon*, Huyk-Choon Kwon

Department of conservative dentistry, College of Dentistry, Seoul National university, Seoul, Korea

I. Objectives

pH varies in the oral environment and on tooth surfaces. The surface of a plaque covered resinous restoration has a low pH. In human dental plaque a number of acids are produced by bacterial metabolism. The predominant acids are acetic, propionic and lactic acids. These acids induced a surface swelling of restorative resin. The swelling cause formation of pores inside the resin matrix from which organic substances can be released, resulting in a mass loss.

The purpose of this study was to qualitatively and quantitatively analyse the leached monomers of dental composites after storage in acetate buffer solution as a function of time by means of high performance liquid chromatography(HPLC) / mass spectrometer and further determine whether pH and time has any influence on the degradation behavior of composite restoration.

II. Materials and method

Three commercial composite restorative resin materials (Z-250, Heliomolar and Aeliteflo) with different matrix structure and filler composition were studied. Thirty specimens(7mm diam. ×2mm thick) of each material were prepared. The material were stored in acetate buffer solution at different pH(4, 7) at 1, 7, 45 days. As references(STD), sample of unpolymerized composite materials of each product were treated with methanol(10mg/ml). Caffeine(100ppm) was used as internal standard. Chromatogram were reconstructed by summing up the peak intensities m/z 10-1000. Identification of the various compounds was achieved by comparison of their mass spectra with those of reference compound, with literature data, and by their fragmentation patterns. The integration of the chromatogram was carried out over the base peak or other characteristic mass peaks of the compound. Data were analysed statistically using ANOVA and Duncan' test.

III. Results

The results of this study were as follows;

1. TEGDMA, UDMA, Bis-GMA, Bis-EMA were detected in which the retention times are 14, 21, 23, 29 min, respectively.
2. Amounts of leached TEGDMA from Aeliteflo were significantly different from those of UDMA from Z-250, Heliomolar as function of storage time and pH change ($p < 0.001$).
3. Amounts of leached TEGDMA, UDMA of pH4 extracts were significantly increased than those of pH7 extracts with storage times ($p < 0.001$).
4. In total amounts of all the leached monomers with storage times, the overall amounts of pH4 extracts were greater than those of pH7 extracts for all resin groups, but there were no significantly different ($p > 0.05$).
5. The most release rate is 0.265% of TEGDMA from Aeliteflo in pH4 extracts and the least release rate is 0.015% of UDMA from Z-250 in pH7 extracts.

IV. Conclusions

Irreversible processes such as the leaching of component occur in acidic solutions simulating a plaque acid, which may contribute to irreversible material degradation. The sensitivity of the degradation behaviour to time and pH of the materials tested seems to be related to the hydrophilicity of the matrix and composition of the filler. Amounts of leached residual monomers should be minimized, either by reducing the mobility within the set composite resins through a high conversion rate, or by applying less water soluble