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Effect of Polymer Molecular Structures on Properties of Dental Cement Restoratives

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Abstract : One of the challenges in dental cement biomaterials is how to make a restorative with mechanical strengths and wear resistance that are comparable to contemporary dental resin composites. Currently none of the dental cement restoratives has been used in high stress-bearing sites due to their low mechanical strengths and poor wear-resistance. The objective of this study was to synthesize and characterize the poly(alkenoic acid)s with different molecular structures, use these polymers to formulate a dental cement restorative, and study the effect of molecular structures on reaction kinetics, viscosity, and mechanical strengths of the formed polymers and cement restoratives. In this study, poly(alkenoic acid)s with different molecular structures were synthesized. The purified polymers were formulated with commercial Fuji II LC glass fillers to form the experimental cement restoratives. The reaction kinetics was studied via 1HNMR spectroscopy. The formed restoratives were evaluated using compressive strength, diametral tensile strength, flexural strength, hardness and wear-resistance tests. Specimens were conditioned in distilled water at 37 oC for 24 h prior to testing. Fuji II LC restorative was used as control. The results show that the higher the arm number and initiator concentration, the faster the reaction was. It was also found that the higher the arm number and branching that the polymer had, the lower the viscosity of the polymer in water and the lower the mechanical strengths of the formed restorative. The experimental restoratives were 31-53% in compressive strength, 37-55% in compressive modulus, 80-126% in diametral tensile strength, 76-94% in flexural strength, 4-21% in fracture toughness and 53-96% in hardness higher than Fuji II LC. For wear test, the experimental restoratives were only 5.4-13% of abrasive and 6.4-12% of attritional wear depths of Fuji II LC in each wear cycle. The aging study also showed that all the experimental restoratives increased their strength continuously during 30 days, unlike Fuji II LC. It is concluded that polymer molecular structures have significant and positive impact on mechanical properties of dental cement restoratives.

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