Investigation and Optimization of Silorane-Based Polymer System

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This research is a collaboration between Department of Oral Biology in the School of Dentistry at UMKC, Department of Chemistry in The College of Arts and Sciences at UMKC, Department of Chemistry at Missouri Science and Technology, and Mo-Sci Corporation in Rolla, MO. The collaborators' expertise includes organic chemistry synthesis, polymer synthesis, materials development, filler preparation/manipulation, analytical/physical/mechanical studies, and biocompatibility.

The purpose of this research is develop alternatives to the current commercial bone cements as well as alternates to current bone stabilization for trauma. In order to do so, the material needs to have optimal polymerization, handling times, biocompatibility, physical and mechanical properties. Current initiators for polymerization have problems due to high exothermicity, toxicity, and low degree of cure. In order to find the ideal material, the initiators whether photo-, chemical or dual needs to be investigated. Methacrylates are the most common resin system in dental composites, however they have problems with polymerization shrinkage as well as cytotoxicity that can lead to biocompatibility issues. Newly developed silorane composites are unique in their low shrinkage (Weinmann, Thalacker et al. 2005; Guggenberger, Weinmann 2000) and improved biocompatibility (Kostoryz, Zhu et al. 2007) over methacrylates. Current bone repair options are methacrylate-based and have many of the same issues as methacrylate based dental composites. New ways to repair bone trauma are

currently being sought out. Siloranes are a viable option that could be used as a bone cement or stabilizer. The resin system for this study is composed of silorane monomers, which will be tested with and without filler. Methacrylate, oxirane, and bone cements are used as references. Polymerization times, pH readings, biocompatibility, and mechanical properties have been tested. Systems will be compared to the two model resin systems along with light-cured silorane (Crivello, Bulut 2006). A main difference between the two resins in question is their polymerization pathways, the free radical polymerization of methacrylates compared to cationic polymerization for siloranes. The different pathways require different chemical curing processes. The long-term goal of this research is to develop new materials, which could be used to stabilize traumatic fractures or as an improved dental composite. The rationale for the proposed research is that due to the reduced stress and good biocompatibility, a silorane system with an optimal initiation system could be a good alternative for conventional bone repair options.

References:

Crivello, J. V.; Bulut, U. (2006) Dual Photo- and Thermally Initiated Cationic Polymerization of Epoxy Monomers. J. Polym. Sci., Part A: Polym. Chem. **44**(23): 6750-6764.

Guggenberger, R.; Weinmann, W. (2000) Exploring beyond methacrylates. Am. J. Dent. **13**: 82-84.

Kostoryz, E. L.; Zhu, Q.; Zhao, H.; Glaros, A. G.; Eick, J. D. (2007) Assessment of cytotoxicity and DNA damage exhibited by siloranes and oxiranes in cultured mammalian cells. Mutation Res. **634**: 156-162.

Weinmann, W.; Thalacker, C.; Guggenberger, R. (2005) Siloranes in dental composites. Dent. Mater. **21**: 68-74.