Temperature Excursions at the Pulp-Dentin Junction during the Curing of Light-Activated Dental Restorations

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Introduction

Heat produced during the curing of light-activated dental restorations could damage the dental pulp. Given the prevalence of composite restorations and the importance of avoiding injury to the pulp, efforts should be made to minimize the temperature increase that occurs at the pulp-dentin junction during light-curing. Finite element method (FEM) modeling is an ideal tool to investigate this problem, as multiple parameters can be varied independently and a large number of cases can be studied in a fraction of the time required for experimental measurements. In this investigation we develop and evaluate a 2D, axisymmetric, FEM tooth model (Figure 1) to simulate temperature increases during light-curing of dental restorations. The necessary parameters were determined from a combination of literature reports and our measurements of enthalpy of polymerization, heat capacity, density, thermal conductivity and reflectance for several commercial dental composites. FEM modeling employed COMSOL Multiphysics (COMSOL Inc.) and the results were validated by comparison to *in vitro* experiments. The model provides a good approximation to the experimental measurements and indicates that the intensity of the curing light, the curing time and the enthalpy of polymerization of the resin composite were the most important factors. The composites are good insulators and the greatest risks occur when using the light to cure a thin layer of bonding resin, or in deep restorations that do not have a liner to act as a thermal barrier.

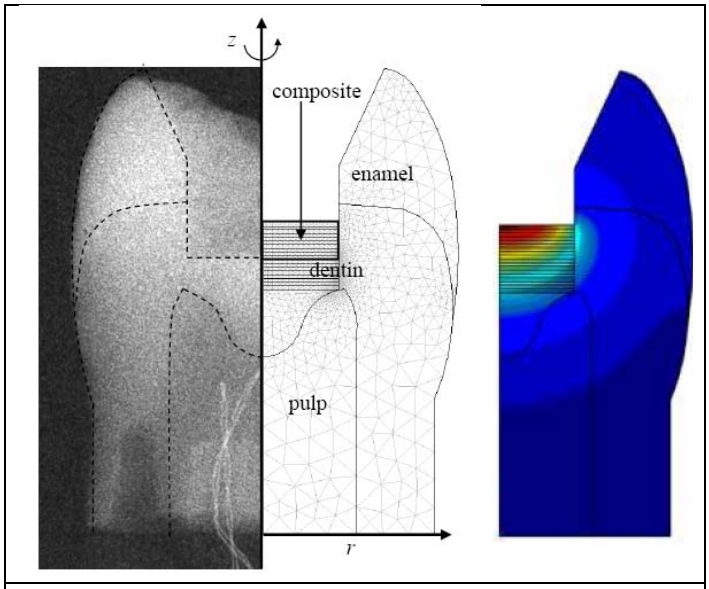

Figure 1: Model tooth