Modeling of Hydrogel-Based Controlled Drug Delivery System for Breast Cancer Treatment

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Abstract

Polymeric hydrogel is a promising class of drug delivery systems with the controlled release behavior in the body. In-situ forming hydrogels can be injected into the body as a fluid which forms a gel within the body tissue and improve the efficacy of the drugs. Various polymers have been used as in-situ hydrogel formulations. These polymeric formulations can form gels at body temperature while maintaining their integrity for a long period of time, allowing the continuous release of the drug. Consequently, the sustained release of the drug reduces the required dose to be injected in the body, and reduces the overall side effects. Drug delivery systems for breast cancer treatment have been modeled with transdermal patches and a wide variety of diffusion coefficients. However, a hydrogel model within a patient specific geometry has not been analyzed. In this study, an MRI scan from a breast cancer patient was reconstructed into a 3D finite element mesh. The mesh was then imported into the COMSOL Multiphysics® software (Fig. 1, 2) and drug release efficiency of the injected hydrogel was investigated. The effects of various parameters of the hydrogel and tumor geometry were studied in detail. As expected, the higher diffusion coefficient resulted in a higher concentration of the drug released in the breast cancer tissue.

Keywords: Hydrogels, Drug Release, COMSOL, Breast Cancer

Figures used in the abstract

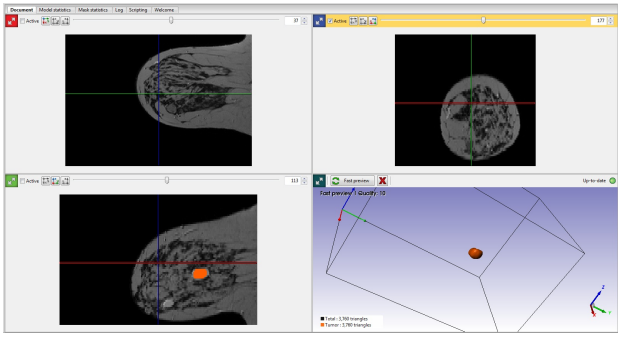

Figure 1: MRI scan of a breast cancer.

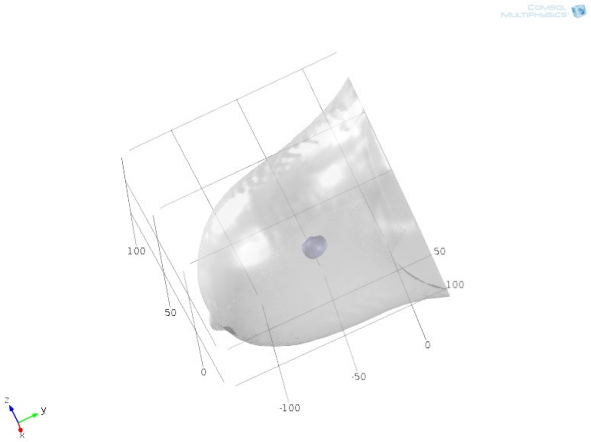

Figure 2: Imported geometry.