Abstract

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Realization and Experimental Assessment of Baseball-Bat Microwave Antenna for Low Power Cancer Ablation

Experimental assessment of using low power microwave ablation for treating focal tumor is presented in this article. Confinement of heating generated by microwave radiation is one of the major concerns in cancer treatment to maintain the acceptable functionality of the organ and alleviate radiation exposure towards surrounding tissues. Development of baseball-bat shaped (BSB) antenna has been studied using electromagnetic and thermal simulations and evaluated experimentally. Numerical simulations showed less than -10-dB reflection stability is attained for more than 20 GHz. Electromagnetic simulation showed that highly directed end-fire radiation achieves confined power deposition within targeted model and yields in higher SAR attained. Nearly spherical ablated lesions are achieved with no healthy tissues being destroyed in the backward direction. Proposed antenna was fabricated and tested in ex-vivo bovine liver sample and egg-white solution. Good agreement between simulated and measured results where confined ablated lesions attained at only 1W were comparable to that obtained at much higher power ranges (20-60W). Efficacy of BSB antenna to efficiently radiate in different dielectric mediums is noticeably attained. The proposed antenna model may help improving the precision of microwave ablation associated with commonly broadside radiators previously used in literature and provide homogenous SAR and confined heating to overcome the limitations found in treating spherical tumors with heterogeneous properties using much high power with narrow-band feature.