Adjustable Zone Microwave Ablation

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According to The National Cancer Institute, over 1.6 million people will be diagnosed with cancer in the United States in 2015. Of those diagnosed, more than 50% of patients experience liver metastasis. Only 30% of patients with liver metastasis tumors will have disease amenable to surgical resection due to high surgical risk or unfavorable anatomy. One successful treatment technique for the removal of tumors formed in the liver has been Radio Frequency (RF) ablation in the last two decades. Recently, microwave (MW) ablation emerged as a new technology with potential to eliminate the problems associated with RF ablation. Some of the problems associated with RF ablation include high power requirements (up to 200W), the use of ground pads and associated skin burns, and the small zone of ablation (~mm). In contrast to RF ablation, MW ablation uses higher frequencies (915 MHz and 2.4 GHz) and work on an electromagnetic energy propagation principle. When the microwave power is turned on, an antenna on the MW probe radiates electromagnetic energy into the tissue creating the ablation zone. As a result, besides the heart, MW ablation can be used for many organs such as lung and bones with higher impedance values where RF ablation would fail. Despite many advantages, there are still major problems associated with the current MW ablation systems. These problems are mainly due to the narrowband nature of the antennas used in these systems.

In this study, we design a wideband antenna for multi-frequency microwave ablation treatment of liver tumors. The antenna is simulated, fabricated, and ex-vivo tested on porcine liver samples. We provide results regarding return loss, SAR, and ablation zones.