Medical Research Institute
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A Microwave Super-Lens Array for Early Diagnosis and Hyperthermia Treatment of Thyroid Cancer by Finite Element Modeling

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ABSTRACT

This work aims to investigate the use of microwave focusing based on metamaterials in hyperthermia treatment. Using hyperthermia as an alternative cancer treatment has become increasingly popular for many years. It has been researched with microwave radiation used successfully to elevate the temperature of cancer cells to approximately 42 °C without harming adjacent healthy tissue. Additionally, metamaterials can treat cancer in organs such as the thyroid gland by focusing electromagnetic absorption on cancer.

A realistic 3D full human neck (3D PTGM) model extracted from segmental (computed tomography) CT images for the tumor-bearing thyroid was performed, followed by exporting the obtained CAD model to the software platform simulation analysis Computer simulation technology (CST STUDIO) to apply adaptive mesh optimization finite element method (FEM), and finally, design an array of microstrip patch antenna applicator and Metamaterial using CST design software to compare outcomes and discuss the most effective methods for detecting and treating thyroid cancer.

CST STUDIO was utilized to estimate the impact of Metamaterial (MTM) on the Specific absorption rate (SAR) and temperature disruption among cancer and healthy tissue within the thyroid gland. A better (Microwave Imaging) MWI with the metamaterial, according to SAR calculations. Without MTM around cancer, there is an insignificant rise in temperature to damage the cancer cells. When MTM materials are used, the temperature of cancer reaches a level suitable for the treatment of hyperthermia (above 42 °C). By using the metamaterial, a better temperature results in the cancer area.