CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Ani Pochiraju; Rohan Rastogi

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31710

Project Title

Bimodal Ultrasound and Optical Approach for Breast Cancer Imaging without Coregistration

Abstract

Objectives/Goals

The aim of this investigation is to test the potential and efficiency of a bimodal ultrasound and optics probe without coregistration in locating a breast cancer lesion in standard breast tissue. Traditionally, there exist many separate techniques that achieve this said task: ultrasound scanning, diffuse optical spectroscopic imaging (DOSI), MRI, CAT scans, etc. Our novel approach combines the strengths of the first two conventional methods of lesion detection into one multi-capability probe. It was hypothesized that we would be able to locate a cancerous lesion in breast tissue, and that the results from our bimodal optical and ultrasound (DOSI/UZ) approach would follow expected biomarker trends.

Methods/Materials

The probe was designed and manufactured with black delrin plastic, steel 5 cm. screws, steel 0.32 cm. set screws, silicone rubber, a clinical ultrasound probe and machine, and DOSI optical fiber imaging technology. Measurements of biomarker concentration and tumor size, position, and depth were then obtained from a breast cancer patient with the help of a trained clinician using our bimodal probe. Consequently, the capabilities of the probe were analyzed using MATLAB software by comparing the biomarker levels of lipid, water (H(2)O), tissue optical index (TOI), hemoglobin (HbO(2)), and deoxyhemoglobin (HHb) to the theoretical trends found in our research. These biomarkers provide functional parameters related to metabolism, angiogenesis, and cell/matrix density of the breast tumor.

Results

As tumor depth increased and the amount of light from the optical instrument interacting with the tumor decreased, we expected TOI to decrease, lipid levels to increase, hemoglobin levels to decrease, and water levels to decrease. Our results followed these expected trends for a comparison between biomarker concentration in the tumor and the depth of the tumor.

Conclusions/Discussion

Our results show that our bimodal ultrasound and optics probe was successful in locating the breast tumor and that the data obtained from our bimodal device was conclusive. Further patient tests will confirm the overall superiority of our technique to conventional ones.

Summary Statement

We tested the potential and efficiency of a new bimodal optical and ultrasound multi-capability probe to image and locate cancerous tumors in breast tissue.

Help Received

Used lab equipment at the Beckman Laser Institute at the University of California, Irvine under the supervision of Dr. Cerussi; basic lab and technological assistance provided by Dr. Darren Roblyer, Shanshan Xu, and Zheng Zhu