

End of the Spectrum

Spectroscopy Sheds a Whole New Light on Breast Cancer Screening

Through a new method that utilizes spectroscopic imaging techniques, researchers at Dartmouth Medical School (Hanover, NH) have taken the stance that they must first understand the properties of healthy breast tissue before they can better detect tissues that are cancerous.

The novel idea comes on the heels of Dartmouth's five-year, \$7-million Alternative Breast Imaging Project, which was funded by the National Cancer Institute. During the study, 23 caucasian women, ranging in age from 40 to 79, who had a history of normal mammograms, were examined by three imaging techniques — near infrared (NIR), electrical impedance, and microwave imaging.

The NIR technique used six wavelengths of light driven by diode lasers in the 690–850 nm range with the light being frequency modulated at about 100 MHz. The microwave technique worked in the 500 MHz to 1–2 GHz range. Finally, the electrical impedance technique worked in the 10 MHz to kilohertz range. The techniques created the computerized images of cross-sections of breast tissues, which the Dartmouth researchers then examined to determine the characteristics of healthy breast tissue.

"I think this method could be used as an adjunctive or supplemental technique to help decipher cases that are mammographically obscure or unclear," says Keith Paulsen of the Thayer School of Engineering at Dartmouth, the study's principal investigator. "But I think we're a long ways away from this being an alternative to mammograms.

"We have been doing this study for about five years," he continues. "A lot of that time was spent in the instrumentation and imaging system development phase. We've been doing the clinical studies for a few years now."

The experimental method identified an array of properties, such as how the breast tissue absorbs light and stores and conducts an electrical charge. It also monitored the amount of oxygenated blood flow in the breast, because breast cancer tissue uses more oxygen and blood to survive.

"We basically have gone from nothing to what we call clinical prototypes," Paulsen says. "We're delivering exams in a relatively efficient time on a daily basis. We're not a clinic, but we're doing a few exams each week.

"I think we're just now getting into the really exciting part," he continues. "We've started to get some information on what the normal breast is like, and now we have some information on the abnormal breast."

The Dartmouth researchers, which include Steven Poplack, a professor of radiology at Dartmouth and the co-director of breast imaging and mammography at Dartmouth—Hitchcock Medical Center, still are trying to determine at what stage of tumor growth the method can be used, but two of the immediate advantages their new process has over mammograms is it eliminates exposure to radiation, and it

provides better detection capability in dense breasts.

Traditional mammograms project the tissue onto two-dimensional planes, but the Dartmouth research method creates a three-dimensional image volume of the tissue. This expedites an easier way of distinguishing between tumors and other fatty, thick matters, which could reduce the number of unnecessary biopsies and missed cases of

breast cancer that happen each year.

"A dense breast is so cloudy that everything is projected on top of it, and you can't really see anything," Paulsen says. "We're making a volume where you can look around at any angle. There's no question the fatty breast is easier to shoot light through than a denser breast."

While it has been a success in its early developmental stage, Paulsen admits the federally-funded project is still five to 10 years away from its completion. The Dartmouth researchers already have requested an additional five years of funding, during which time improvements and technologies can be introduced, and additional studies with women of different races can be conducted.

"There's a lot of ways we can improve the instrumentation," Paulsen says. "We're still trying to understand what these images mean. These are new types of images that no one has ever looked at before."

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