UF BME Faculty Member Huabei Jiang: ‘Optical biopsy’ for breast cancer increasingly accurate

Most biopsies following mammograms reveal benign abnormalities, not cancer. But women may not have to endure the medical costs, stress and potential complications that accompany such invasive biopsies forever. A University of Florida biomedical engineering researcher is making progress on an “optical biopsy” that has the potential to determine whether growths are cancerous without ever puncturing the skin.

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“At this stage, it is just too early for optical tomography to be a screening tool,” said Huabei Jiang, the J. Crayton Pruitt Family professor of biomedical engineering, who has spent more than a decade developing the technique at UF and Clemson University. “But you can pretty much say that it is highly likely it can become a diagnostic tool, an adjunct to X-ray mammography.”

Surgical biopsies have long been the gold standard for determining whether growths are cancerous. But at least three out of

four biopsies following mammograms conclude that observed abnormalities are benign and that no intervention was needed, Jiang said. Depending on if the biopsies are performed with needles or surgery, that can mean added cost, recuperation and potential scarring or other complications -- all ultimately unnecessary.

Jiang has devoted much of his career to an alternative: "phase-contrast diffuse optical tomography," a screening technology that roots out breast cancer not with cutting tools and laboratory tests but with light and computing power.

He recently completed the third generation of his apparatus -- a bed with an array of fiber optic laser lights and detectors mounted within a hole where the patient places her breast.

Light from the harmless lasers enters the breast and scatters. Most gets absorbed in the tissue, but some reaches the detectors. With enough light hitting the detectors from enough different directions, there is sufficient data for Jiang's computer algorithms to create an image of the breast's interior. This image suggests either benign conditions or some of the telltale signs of cancer that are completely invisible to standard X-ray mammograms -- for example, a high density of blood vessels snaking around a likely tumor.

But the image is just one indicator. In Jiang's newest apparatus, undergoing tests at the Tampa-based Moffitt Cancer Center, fiber optic lights span 10 different wavelengths, or colors. Light with these colors changes in predictable ways when they strike certain compounds, such as oxygenated hemoglobin, water or lipids. Just as light collected from distant planets can reveal the composition of their atmospheres to astronomers, so light collected from these collisions can indicate chemical evidence of cancer.

A third technique, known as index refraction or phase contrast, provides information on cellular size and density -- both factors that play into determination of cancer in laboratory biopsies.

"What he's done is introduce a whole new optical property that is pretty clever," said Steve Ponder, of the phase contrast element of Jiang's research. "It's another tool, and he's reported good success, and it did increase sensitivity."

Ponder is director of advanced development for the Fort Lauderdale-based Imaging Diagnostic Systems Inc., which makes breast imaging devices that rely on similar technologies to those Jiang is developing.

Over the past 10 years, Jiang and his graduate students have tested their evolving device on a total of about 200 patients, he said. In a 2008 paper in Academic Radiology, his most recently published clinical paper, he obtained 35 images from 33 patients and compared his findings with the results of the women's traditional biopsies.

His main conclusion: His technique correctly identified biopsy confirmed malignancies nearly 75 percent of the time, with the most accurate results from older patients, whose softer breasts make abnormalities more prominent. Jiang said he has since boosted the accuracy rate to 91 percent in a study involving 144 women, but he is still readying that study for publication. More research and more patients are needed, he said.

"It's still not enough for us to say, 'O.K.'," he said. "But we have some confidence."

The National Cancer Institute has provided the bulk of about $2 million in research support for Jiang's efforts. His current collaborators include Moffitt Cancer Center, a UF partner institution.

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