
RSNA Press Release

Terahertz Imaging May Reduce Breast Cancer Surgeries

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OAK BROOK, Ill.—A promising new technique to ensure complete tumor removal at breast cancer excision is introduced in the May issue of *Radiology*.

Researchers used light waves in a newly explored region of the electromagnetic spectrum—the terahertz region—to examine excised breast tissue and determine if the removed tissue margins were clear of cancer, with good results. This technology has the potential to eliminate the need for multiple surgeries and tissue samples to get clear surgical margins.

"We found that terahertz light could reliably distinguish between normal breast tissue, tumor and even early-stage 'in situ' cancers in excised tissue samples," said Vincent P. Wallace, Ph.D., lead investigator at TeraView, who worked with Addenbrooke's Hospital in Cambridge, England, in conducting the study. "This technology could aid the surgeon in immediately identifying residual cancer after the main tumor has been removed, thus minimizing the need for additional surgical procedures."

Currently, excised tissue samples must be sent for histopathologic examination, which typically takes several days. Thus, surgeons don't know if all the tumor has been removed until well after the surgical procedure has been completed, and often, repeat surgeries have to be scheduled. For the first time, however, terahertz imaging has the potential to eliminate the need for subsequent procedures by allowing the surgeon to analyze tissue samples during the initial excision procedure.

Terahertz light is located between the infrared and microwave portions of the electromagnetic spectrum. The researchers found that by placing a slice of excised breast tissue on a special quartz plate and exposing it to terahertz light, the light waves reflected from the tissue contained unique information about its state. The researchers were able to distinguish both invasive and noninvasive breast carcinomas from healthy tissue.

Twenty-two excised breast tissue samples were obtained from 22 women who underwent

At A Glance

- In early studies, terahertz imaging reliably distinguished tumor from healthy breast tissue in excised tissue samples.
- Terahertz technology can feasibly allow surgeons to get clear margins during surgery instead of requiring multiple procedures and tissue samples.
- The use of terahertz imaging can potentially reduce patient morbidity and healthcare expenses.

either wide local excision or mastectomy to remove breast cancer. All samples were first sliced and imaged with terahertz light, and then submitted for histopathologic analysis. Imaging took less than five minutes.

"There were substantial differences in the optical properties of normal and diseased tissue," Dr. Wallace said. The size and shape of the diseased regions at terahertz imaging were compared with those at histopathologic examination, with good results. All but three samples yielded invasive cancers. In total, there were two invasive lobular carcinomas, 14 invasive ductal carcinomas, three mixed invasive ductal and lobular carcinomas, two cases of pure ductal carcinoma in situ and one dense radial scar.

In breast cancer excision surgery, the aim is to remove the entire tumor with an adequate margin of normal tissue, while minimizing the amount of healthy tissue being removed. If a histopathologist analyzes the tissue and finds tumor at or near the edges, this indicates that there is a higher chance of cancer recurrence. A second operation is required to remove more tissue, involving additional hospital resources and increased risk of patient morbidity. Thus, there is a clinical need to accurately define the margins of the tumor during surgery.

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"Terahertz Pulsed Imaging of Human Breast Tumors." Collaborating with Dr. Wallace on this paper were Anthony J. Fitzgerald, Ph.D., Mercedes Jimenez-Linan, M.D., Ph.D., M.R.C.Path., Lynda Bobrow, M.B.B.Ch., F.R.C.Path., Richard J. Pye, M.A., M.D., F.R.C.P., Anand D. Purushotham, M.B.B.S., M.D., and Donald D. Arnone, Ph.D. TeraView did not fund this study.