Optical imaging is an emerging imaging technology that uses lasers to illuminate superficial tissue with the potential to offer new approaches in the prevention and treatment of breast cancer as well as other diseases. By combining laser light of different wavelengths with an optical dye, tumors can be targeted more precisely. Due to its high resolution and sensitivity, optical imaging is expected to offer breast cancer patients a less aggressive follow-up examination than the traditional biopsy procedure.

This new imaging modality has gained much scientific interest in the past. Dutch company Philips has now joined forces with pharmaceutical company Schering (Berlin, Germany) to use optical imaging for the early detection of breast cancer.

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How does optical imaging work?
The technology makes use of the fact that diseased tissues have different laser-absorption characteristics. In addition to the tissue-illuminating lasers, the breast imaging equipment comprises a table with a cup in which the breast is placed. A total of 512 fibres are positioned within the cup. Fifty percent of those fibres can be coupled to lasers with different wavelengths, and the other half are connected to highly sensitive detectors. Using this setup, light can be detected through a tissue depth of 15 to 20 cm. After injection into the bloodstream, the optical fluorescent dye omo-cianine is excited by one of the lasers with the appropriate wavelength. Upon radiation, the dye will emit light of a different wavelength that can also be detected by the 256 detectors. Combining the measurements obtained and using a special computer algorithm, an image of the breast is generated and potential lesions become apparent.

The partners expect this technology to be available early in the next decade, once the extensive series of clinical research trials has been completed.

Potential benefits of optical imaging
The earlier breast cancer is detected, the better are the chances of treating it effectively. X-ray mammography, which is the current standard for breast cancer screening, can depict breast microcalcifications, however, these X-rays cannot image soft tissue, and can thus not identify the difference between normal breast tissue and non-hardened lesions. In addition, mammography exams can be uncomfortable and malignant lesions can escape detection, albeit infrequently.

Possible benefits of optical imaging include:
- The absence of potentially harmful radiation
- High accuracy, sensitivity and specificity (The high sensitivity may be particularly useful for younger women with dense breast tissue)
- Less painful/more comfortable procedure
- Symbiosis of equipment and agents
- Fewer unnecessary biopsies by clarifying suspicious X-ray mammography diagnoses
- Easily repeatable
- Holds potential for other therapeutic applications.

Optical imaging in the wider clinical context
Initially, the research will focus on all applications related to optical imaging equipment and contrast agents for the prevention and treatment of breast cancer. It is conceivable that, at a later stage, the value of optical imaging for detecting diseases of the periphery of the body (i.e., a depth of 5 to 10 cm) will be studied. This could include rheumatoid diseases (e.g., arthritis) for which there currently exist no good diagnostic technologies. Other focus areas could include skin cancers, osteoporosis and diseases related to the lymph nodes.

The future of optical imaging
The key to defeating many diseases is detection even before symptoms appear. Technological advances, such as optical imaging, are expected to contribute to a future in which disease is detected and treated at the cellular level. Development of targeted optical contrast agents, which can image the molecular fingerprints of different malignancies, is at the forefront of current joint research efforts with Schering. Driven by the development of biocompatible fluorescent markers, advances in imaging technology and refinements in the mathematical models that make sense of the chaotic paths photons travel as they careen through the body, these advances are helping researchers accomplish important goals in securing the future of optical imaging: improvement of light penetration, image resolution, and the quantification and localisation of disease.

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