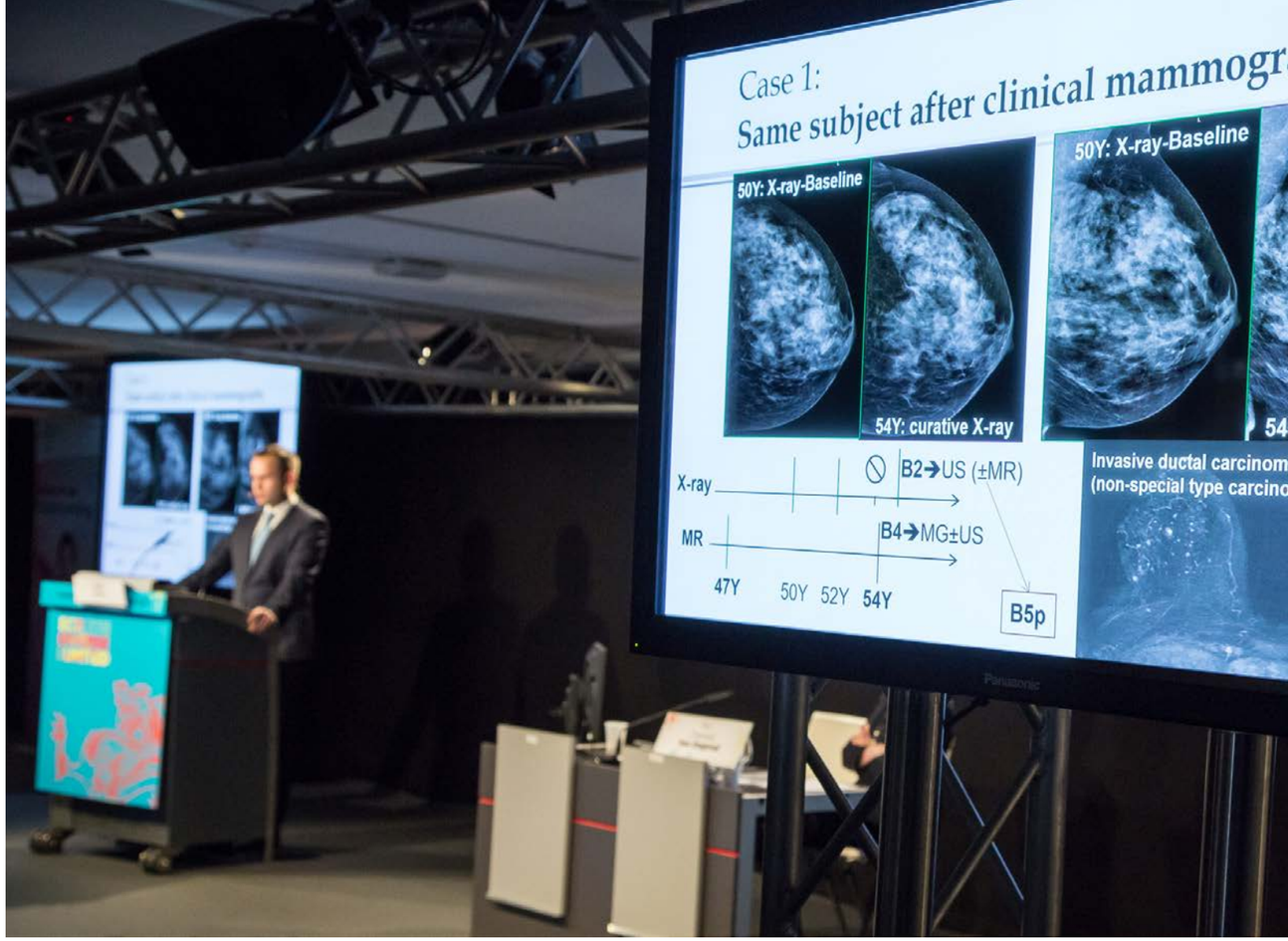
Tomosynthesis and Contrast-Enhanced Mammography Improve Cancer Detection

Although tomosynthesis – or 3D mammography – has only recently emerged as a promising tool in breast cancer detection, image acquisition and interpretation strategies are now being optimized through technological and reading workflow improvements, according to expert discussions at the European Congress of Radiology. Coupled with contrast enhancement, mammographic techniques now even enable functional imaging of cancer tissue.

Text: Martin Lindner



Experts at the European Congress of Radiology explained that new mammographic methods could take breast cancer detection to a new level. More specifically, optimized tomosynthesis protocols and contrast-enhanced images offer promising possibilities.

A new standard in breast cancer detection

In recent years, a range of advancements in digital mammography have helped to greatly improve breast cancer detection. Indeed, in many countries, these developments are changing the way radiologists work. Key to this is an improved morphological and functional assessment of breast tissue. This was recently illustrated in discussions with experts in the field at the Breast Care Day, which was co-organized by Siemens Healthineers and Bayer, during the European Congress of Radiology (ECR) in Vienna.

In particular, tomosynthesis, also known as 3D mammography, offers the potential for significant clinical improvement. “The superiority of digital breast tomosynthesis compared to digital mammography for cancer detection in screening is undoubted,” said radiologist Sophia Zackrisson of Lund University, Sweden, who directs an extensive cohort study that compares one-view tomosynthesis with two-view digital mammography for screening purposes.[1] According to the study’s final results, which are now being prepared for publication, over 30% more cases of breast cancer could be detected using the 3D reconstruction method than with conventional two-view digital mammography – a development that coincides with other investigations, reported Zackrisson.

Many experts see tomosynthesis as a new diagnostic standard – one that could become established in the future for population-wide screening programs. However, to reach that level, reading times, which are currently up to twice as long with tomosynthesis as with conventional mammography, will have to be shortened. Here, the crux of the problem is the sheer quantity of image material. One strategy for overcoming this is to combine several of the reconstructed cross sections into thicker image layers

("slabbing"), said Zackrisson. Another promising possibility might be computer-assisted reading approaches in which, for example, intelligent algorithms sort out normal scans beforehand, thus easing the workload of the radiologist. "CAD and AI are definitely a way forward," said Zackrisson.

Optimizing image acquisition and reconstruction strategies

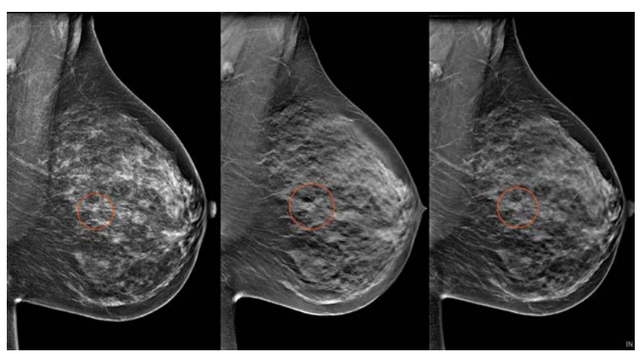
It should be noted that the technical parameters of image acquisition already play a role in the efficiency of tomosynthesis. During a procedure, an X-ray tube goes around the breast in order to obtain image projections from different perspectives for 3D reconstruction. According to radiologist Paul Fisher and medical physicist Wei Zhao, both from Stony Brook University, New York, if an X-ray source has a larger angular range, image quality appears to be higher than in the case of a smaller angular range. This is explained by the fact that, in the case of a wider angle, the inside of the breast can be viewed more easily and thus fewer data artifacts are necessary for image reconstruction.

Based on model simulations, Fisher and Zhao's team conducted a clinical pilot study in which radiologists compared images from two different tomosynthesis systems with angular ranges of 15 and 50 degrees, respectively. The result: Especially in very dense areas of the breast, in which foci of cancer often remain masked by surrounding tissue, suspicious masses can be better detected by a wide-angle system, according to Fisher and Zhao. Whether cancer detection can also be optimized in everyday clinical practice as a result remains to be proven by larger studies. However, an earlier investigation based on the use of phantoms demonstrated that image reconstructions by wide-angle systems have less signal noise and tend to be preferred by radiologists.[2]

Also important for the reading process is easy orientation in the tomosynthetic image material. Currently, conventional full-field digital mammography (FFDM) is therefore often performed in addition to tomosynthesis, to expedite image interpretation and facilitate comparisons with prior images, using the overview image in 2D.

Now, however, an alternative to FFDM is a "synthetic" mammogram reconstructed from tomosynthesis data, explained Paola Clauser from the Medical University of Vienna, Austria. "Synthetic mammography provides a reliable 2D image – without the need for a double radiation exposure," said Clauser. Other studies have supported the diagnostic value of this approach. Conventional mammography remains in its own right superior to synthetic images, yet in combination with tomosynthesis, they represent a trendsetting approach.

Invasive lobular carcinoma grade 2: In 15° Tomo finding is inconclusive while the 50° Tomo shows the finding definitively. *Courtesy of Wayne Lemish, MD, MIA Radiology, East Melbourne, Australia*

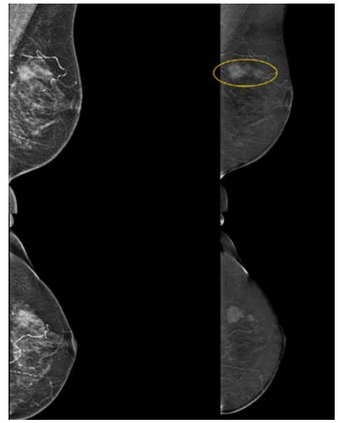


ILC 1.8 cm with DCIS G2 10 cm: FFDM, DBT and synthetic mammogramm.
Courtesy of Prof. Th. Helbich, MD, Maria Bernathova, MD, Paula Clauser, MD, University Hospital Vienna, Austria

Towards functional diagnostics in mammography

Yet another new paradigm is emerging: the use of mammography for functional imaging. This is based on the fact that, in order to grow, breast tumors form new blood vessels.[3] This neoangiogenesis can be made visible at a high resolution if a contrast agent containing iodine is given during the examination, explained Luis Pina from the University Clinic of Navarra, Spain. The method, known as contrast-enhanced dual energy mammography, works with X-rays of different energy levels, which are attenuated to different extents by breast tissue and the iodine contrast agent. In addition to a low energy mammographic image, that can be compared to a conventional mammogram, a high energy image is acquired leading to a calculated subtraction image, which sets apart and unmasks heavily perfused tumor tissue from its surrounding area.[4]

"The approach is a problem-solving technique," stressed Pina. In cases that cannot be sufficiently clarified through mammography or tomosynthesis, the contrast agent method often provides further help, for example, in the case of particularly dense breast tissue, preoperative staging, or follow-up of scars. In many constellations, the method offers an alternative to magnetic resonance imaging, which – if applicable – takes longer and can be quite costly.



71-year-old lady with a palpable lump (left breast): The mammogram shows an irregular mass, margins are not clearly seen; the size of the cancer is difficult to assess. TiCEM shows the real size of this 30 mm invasive lobular carcinoma.
Courtesy of Prof. Luis Pina, MD, University of Navarra, Pamplona, Spain

In addition, contrast enhancement is also possible in tomosynthesis[1], as Fisher added. According to initial study results with a prototype system, contrast-enhanced tomosynthesis enabled a particularly good assessment of the diagnostically important margin areas of lesions suspected of being cancerous. Moreover – as in the case of examinations without a contrast agent – synthetic 2D overview images could be generated.

The latest diagnostic systems, such as MAMMOMAT Revelation, actually integrate all of these methods and can be used for traditional as well as contrast-enhanced mammographies, tomosynthesis, synthetic image reconstructions and image-guided biopsies. These advanced devices allow radiologists to choose the best approach in each case from a growing repertoire of methods, depending on the clinical constellation. ●

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[1] Prototype
This product is under development and not commercially available. Its future availability cannot be ensured.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Because there is no "typical" hospital or laboratory and many variables exist (e.g., hospital size, samples mix, case mix, level of IT and/or automation adoption) there can be no guarantee that other customers will achieve the same results.

Results from case studies are not predictive of results in other cases. Results in other cases may vary.