

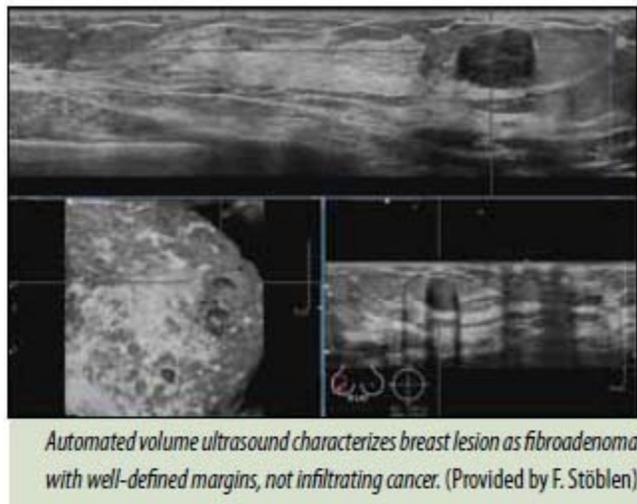
Auto 3D rids ultrasound of 'subjective' tag

Preprogrammed trajectories ensure every inch of breast is imaged

By PAULA GOULD | June 4, 2010

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Operator dependency has long been regarded as ultrasound's Achilles heel. The performance of handheld ultrasound is inextricably linked to whoever's hands are holding the transducer: tissue may inadvertently be missed from the scan, and pathology overlooked during the real-time image interpretation. The need for truly expert operators, coupled with the time required to perform a thorough examination, have consequently restricted the role of ultrasound to that of a second look modality in breast imaging.



The rationale for reserving ultrasound for problem-solving alone could now be challenged, following a resurgence of interest in automated breast ultrasound. Several such systems, that promise to rid breast ultrasound of its subjectivity and provide 3D volume images, are now appearing on the market. The current offerings include a water-bath setup, reminiscent of 1970s and '80s technology, where women lie prone with their breasts suspended in a tank of warm water. Other vendors are pursuing a more conventional supine imaging setup, in which an extended B-mode transducer sweeps across the breast, following three different preprogrammed trajectories to capture the entire 3D volume of tissue.

Automation has removed subjectivity from whole-breast ultrasound examinations and made it easier to verify results, according to Dr. Frank Stöblen, a radiologist and co-owner of the Diavero breast imaging center in Essen, Germany. Less experienced operators may miss very small lesions when examining large-breasted women with handheld ultrasound, simply because they fail to cover all of the tissue, he said. The automated volume scan makes sure that every inch of the breast is imaged. In addition, because the images are viewed on a separate workstation, not the ultrasound machine, they can be double-read to improve diagnostic accuracy.

“With automated volume scanning, you are able to cover the whole tissue,” he said. “You have an objective, whole-tissue volume that can be read afterward on a workstation by one or two doctors—or maybe by additional experts too. A second opinion is always possible.”

The advent of automated volume imaging could potentially provide ultrasound a way in to the screening arena. Interest in a combined mammography/ultrasound screening protocol was stimulated by results from the American College of Radiology Imaging Network (ACRIN) 6666 trial, which showed that together the two modalities could detect more cancers in women at high risk for breast cancer who had dense breast tissue than two-view mammography alone.

One downside of the revised protocol, acknowledged by the study’s authors, was the time needed to perform a bilateral breast ultrasound examination. Given the average scan time of 19 minutes, it would be “problematic” to try and include this additional scan into an annual screening program, they noted. This obstacle could, however, potentially be removed if the imaging procedure were automated and doctors no longer needed to hold the probe. An expert reader would still be needed, but by separating the two parts of the process, data acquisition and reporting, physician time would still be saved. **“There has to be a better way for us to evaluate high-risk patients with dense breasts,”** said Dr. Marcela Böhm-Vélez, a clinical assistant professor of radiology at the University of Pittsburgh in Pennsylvania and a partner of Weinstein Imaging Associates, also in Pittsburgh. **“We know we can detect additional cancers in this group of women, but there is no way we can screen them all with handheld ultrasound. There simply aren’t enough breast imagers out there to do it.”**

Women with an intermediate risk of breast cancer, that is, a 10% to 20% lifetime risk of developing the disease, may benefit most from automated breast ultrasound screening, according to Böhm-Vélez. MRI is currently recommended in Europe and the U.S. as an adjunctive screening tool for women at high risk (20% or above) of developing breast cancer. Women at intermediate risk of breast cancer are not eligible for anything other than mammography, yet they may also have dense breast tissue, which confounds the accuracy of x-ray–based screening tools

MORE TO SEE

Automated breast volume ultrasound is not, however, simply a faster, less subjective alternative to handheld scanning. The 3D nature of the examination means that more breast anatomy can be visualized, not least because the data can be reconstructed into three orthogonal views: transverse, sagittal, and coronal. This latter view, also known as the bird’s eye view, provides physicians with a slice-by-slice assessment of anatomy from the skin down to the chest wall, a perspective that is not available from conventional 2D breast ultrasound imaging.

The coronal view may be particularly useful when cancer is confirmed and resection is planned, Stöblen said. He prefers to use the term “surgical view,” because the breast is displayed in the same orientation as that seen by surgeons when the patient is lying on the operating table.

The position of a lesion in relation to the nipple can be defined precisely when using the coronal view, said Prof. Dr. Detlev Uhlenbrock, co-owner of a dedicated radiology and radiotherapy clinic at the St. Josefs-Hospital in Dortmund, Germany. This makes it easier for the surgeon to plan an excision route that will spare adjacent healthy tissue from injury. Another advantage is the speed with which overview of the breast can be obtained.

“Assuming you take an identical slice thickness, it takes more steps to cover the whole breast from inferior to superior compared with the coronal view from the nipple to the thoracic wall. Therefore, it takes less time to get a first impression of a pathological structure within the breast tissue,” he said.

It may be easier to view the full extent of disease with the coronal view, though nothing is proven yet, Böhm-Vélez said. She is also optimistic that 3D imaging data will help improve the specificity of breast ultrasound, though again, more data are needed.

“One of the first cases we had was a tiny little cancer with spiculations best demonstrated on the coronal view,” she said. “The more we use the coronal view, the more we become familiarized to this new projection. I think we are going to find that it gives us additional information, hopefully helping us to decrease our biopsy rate.”

DISEASE SCREENING

The issue of unnecessary biopsies becomes moot if breast ultrasound is considered for disease screening. Although the combined ultrasound/mammography protocol followed in the ACRIN 6666 trial increased cancer detection, it also raised the false-positive rate. The significance of this downside is, of course, debatable: ultrasound-guided core biopsy and fine-needle aspiration are simple, fast, inexpensive procedures that can be performed immediately. Nonetheless, even if the results are negative, women may still be left with needless, lingering anxieties.

But it was handheld 2D ultrasound, not automated 3D breast ultrasound, on trial in the ACRIN 6666 investigation. Data gathering on this new modality is now beginning in earnest, with the establishment of a multicenter clinical trial involving sites in Germany, the U.S., and Japan.

“We need valid data, especially a comparison between handheld ultrasound and automated breast volume scanning,” Uhlenbrock said. “Automated volume ultrasound should at least demonstrate nearly the same number of carcinomas as handheld ultrasound. The question is whether it will have the same positive predictive value. With handheld ultrasound, you can use the compression of breast tissue as an additional marker of differentiation between what is benign and what is malignant.”

Stöblen is doubtful that automated volume ultrasound on its own will decrease the number of biopsy requests. The modality’s main strength is lesion detection, not characterization, he said. The addition of elastography could help add specificity, but this is not yet available on automated scanners. He is optimistic, however, that data from automated volume ultrasound scanning will make it easier to find small lesions on targeted ultrasound examinations prior to biopsy.

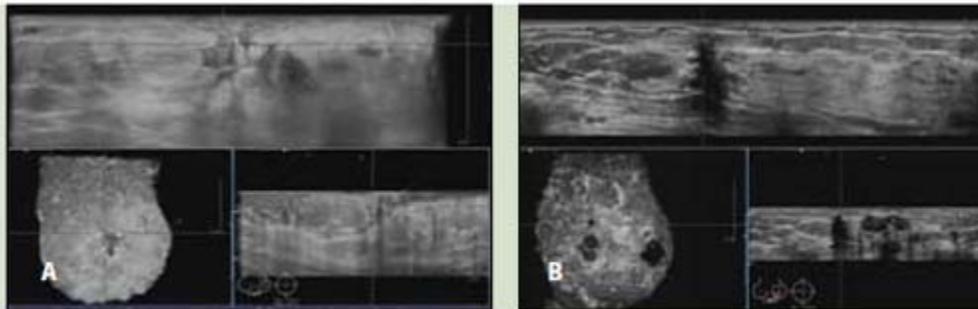
“Previously, we used to talk about finding lesions that were 1 cm or 8 mm with 2D handheld ultrasound,” he said. “Now, if you know from the volume data set that you are looking for a lesion that is just 3 or 4 mm, as is often the case with screening populations, then targeted ultrasound will be able to find that lesion.”

LEARNING CURVE

Automated breast volume ultrasound is, of course, a little more complex than press and go. Users agree that operators will need to familiarize themselves with the technology, for example, by ensuring that there is good contact with tissue throughout the examination.

“At the moment, I am only having my ultrasound technologists do the scans,” Böhm-Vélez said. “My intentions are eventually to have my mammography techs do it too, and in terms of positioning, they should actually be very good at it. With time, I think you could teach any technologist to do this, but as with all new technologies there is a learning curve.”

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A. Automated volume ultrasound shows cancer growing out of nipple. B. Multiple fibroadenomas and cancer, as depicted on automated volume ultrasound examination. (Provided by Siemens)

Initial study data have also revealed that interpreting images gathered by automated breast ultrasound systems is an acquired skill. Data presented at the 2010 European Congress of Radiology in Vienna by Dr. Per Skaane, a radiologist at Ullevål University Hospital in Oslo, revealed considerable interobserver variability between five radiologists who were asked to interpret a series of automated breast volume ultrasound images. The same five readers rereported the images six weeks later in tandem with results from digital mammography. All were more competent at reading volume scans the second time around, though the difference in degree of improvement between the readers was deemed to be significant.

Reporting an automated breast volume examination can take anything from five to 35 minutes, depending on the reader's experience and the complexity of the case, said Dr. Ellen Mendelson, chief of breast and women's imaging at Northwestern University in Chicago, Illinois. Cross-correlation between the multiplanar reconstructions does, however, speed up the process of scrolling through 2000 to 2500 images, and gathering as much information as possible on suspect findings.

“You speed up as you gain experience, and you realize how to navigate through all these images. It is a similar process to learning how to read breast MRI,” she said.”