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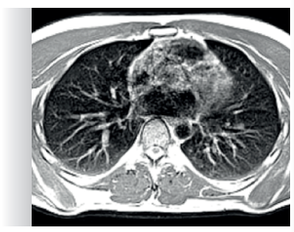
DIAGNOSTIC IMAGING EUROPE

SMALLEST, LIGHTEST WHOLE-BODY MRI



The Magnetom Free.MAX from Siemens Healthineers considerably improves pulmonary imaging with MRI.

Contrast-Enhanced MRI: validating the truth

A report of the recent symposium on CE-MRI, sponsored by Bracco Imaging at the recent ECR 2020 virtual meeting.

Improving mammography efficiency and workflow through Artificial Intelligence and SmartSlices

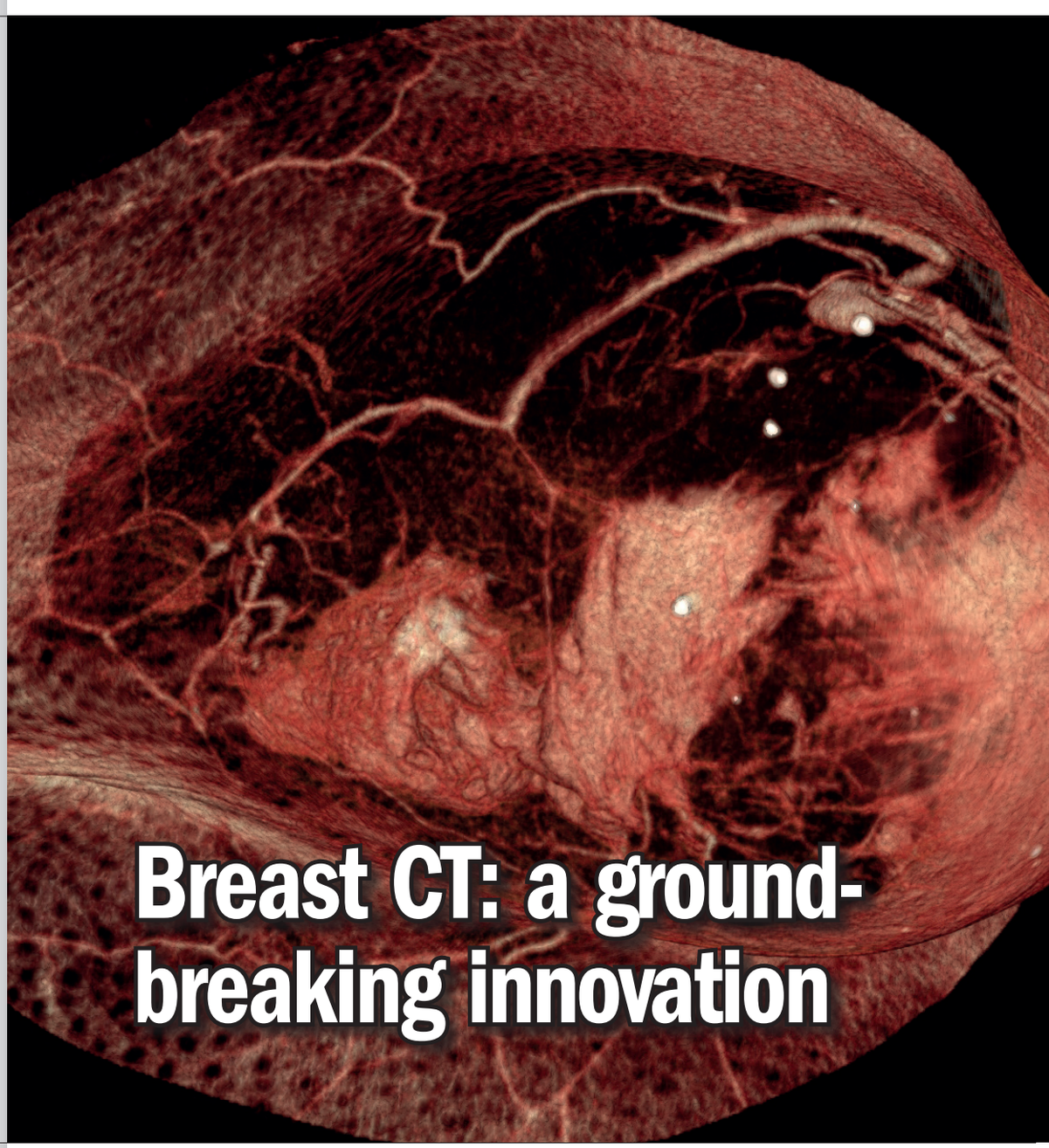
MR detection and classification of prostate lesions using AI

Reduced stress and consistent contrast-enhanced MRI scans

Radiologists make more errors interpreting off-hours body CT studies during overnight assignments compared to daytime assignments

Solving the persistent shortage of clinical data available to medical algorithm developers

Imaging News
Industry News
Technology Update



Breast CT: a ground-breaking innovation

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Breast CT - a ground-breaking innovation

With a total of thirteen separate clinics, the private radiology practice of "MVZ Prof. Dr. Uhlenbrock & Partner" provides an important clinical imaging service to the Ruhr area of Germany and has a high reputation for clinical excellence and technological innovation. In keeping with its tradition of investing in clinically relevant state-of-the-art technology, the group has recently installed an innovative CT system specifically designed for breast imaging.

We wanted to find out more about the radiology practice in general and the new breast CT system in particular, so we spoke to Dr. Karsten Ridder, radiologist in charge of breast imaging.

Dr. Karsten Ridder, Breast radiologist in the practice of MZV Prof Dr. Uhlenbrock & Partner.
e-mail
k.ridder@mvz-uhlenbrock.de

Q *Before we get on to the new breast CT system, please give us a brief background to the MVZ Prof. Dr. Uhlenbrock practice. Where are the individual clinics located –all in North Rhine Westphalia?*

The practice was founded in 1993 by Prof. Detlev Uhlenbrock and since then has grown and established a reputation as being one of the leading medical centres in the Ruhr area in Westphalia, Germany. As you mentioned in your introduction the practice is composed of 13 individual clinics, most of which are associated with, and linked to, a hospital. Right from its foundation, the mission of the practice has been to offer efficient out-patient facilities but also to cultivate fruitful collaborations with hospitals. In total the practice has more than 450 employees providing services in radiology, radiotherapy, nuclear medicine and laboratory diagnostics, which represent our core competences. Some of these are bundled —for example interventional procedures are only provided at three locations.

Each year we see more than 290 000 patients of whom three-quarters are out-patients. We are equipped with a complete range of modern equipment offering all imaging modalities ranging from DR X-Ray to high-end cardiac CT, from plain ultrasound up to PET-CT; and from MSK-MRI up to 3Tesla neuro-imaging.

Our philosophy has always been to be ready to take advantage of the latest technologies, provided always that there is a clinical benefit. The installation of the Mamma-CT is a perfect example of this type of thinking and is just the latest of many state-of-the-art innovations we have introduced throughout our history. However it's not just technology for technology's sake — we also put a great emphasis on the continuous education and competence of our staff who use the technology.

Q *Now let's focus in on breast imaging in your practice.*

Of all our imaging modalities, mammography was in fact the last to go digital with the acquisition in 2000 of our digital Mammo-System (Siemens CR-System). Since then we have continuously updated and have become a reference-site for Siemens over the last 20 years. Thus, we were the second site world-wide to install digital breast tomosynthesis and were the first clinical practice to implement Contrast-Enhanced Mammography (CEM) a few years ago and, more recently, the titanium-filtered variant of CEM (Ti-CEM). However we are not wedded to any one specific vendor – for example, the four MRI systems in my practice in Dortmund are from Phillips.

The nu:view Mamma-CT system was developed and is produced by the German company AB-CT - Advanced Breast CT. The design of the new scanner allows compression-free imaging of one breast at a time. To do this, the breast CT system uses a rotating gantry on which the X-ray tube and photon-counting detector are mounted. During the image acquisition process, the gantry rotates around the breast in a downwards-oriented spiral trajectory. In the course of a single scan up to 12,000 projection images are acquired. A full spiral scan takes as little as 7 – 12 seconds.

But back to breast imaging — we see about 55000 women each year of whom 55% are screening cases (we are now the leading screening center in the Dortmund area). The other 45% of women we see are referred by our local gynecologists or from the clinics we work with. Together all these collaborators form a strong local network which we actively encourage, for example by giving conferences and supporting workshops/webinars, etc., on top of the "normal" daily workload.

Thanks to the reputation we have built up in the Ruhr area, nearly 85% of our patients come from the local region. However since we have had the Mamma-CT we have noticed that, more and more, patients are being referred to us from all over Europe.

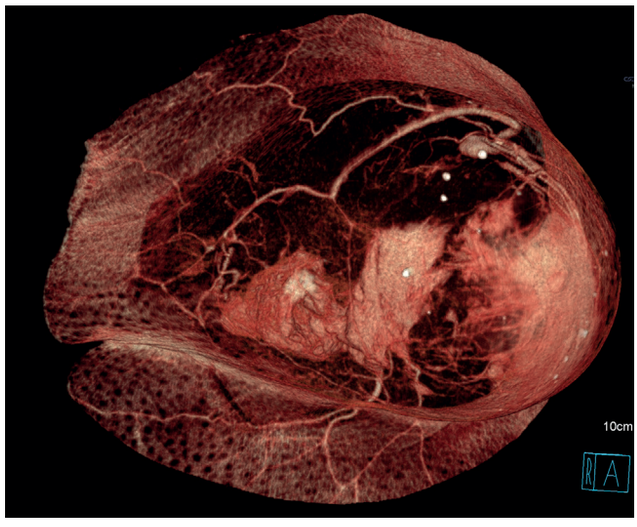
Q *What is the usual work-up of patients after mammography or tomosynthesis scans in your practice ?*

We faithfully follow the guidelines and therefore we try to optimize the diagnostic procedures for each single case. Personally, I am a great fan of the "*keep it simple*" approach and I am used to working in a straightforward manner. In most cases, after mammo, tomosynthesis or spot-imaging the clinical situation is quite clear and we can deal with it using handheld ultrasound, although I also routinely use elastography and power-duplex as additional tools. However if there is a suspicious lesion I, as a radiologist, have to decide which supplemental modality is most appropriate to achieve a definitive result and a reliable diagnosis for the patient. The category that I personally hate most is "BIRADS III" where often the best advice I can give to the woman is "*I am not sure – come back in 6 months*". Of course this message is not satisfactory, so I try to avoid it as much as possible. We have two automatic breast ultrasound (ABVS) systems, but in practice it is quite complicated to integrate the ABVS procedure into our routine workflow, although the technique has the potential to become a nice tool for ultrasound screening purposes in future.

As for biopsies, we have been performing them routinely for 25 years, so we have a built up a vast experience in biopsies with all modalities (ultrasound/mammo/MRI). The level of our benign biopsies is about 45% but this is influenced and increased by the number of screening cases we see.

Q *What about dense breasts?*

These are always a challenge in conventional breast diagnostics. In the patients we see there is a normal distribution of density. For the last two years we have been using separate software to make density measurement more objective and reliable. In cases of dense breasts without prior images we routinely add at least a tomosynthesis and ultrasound to the work-up. For microcalcifications I rely most on magnification – or spot-imaging, although the latest tomo-algorithms with iterative reconstruction are a lot better than the old filtered -back projection approaches. If there is still a suspicion or uncertainty about carrying out a biopsy right away we may turn to Ti-filtered CEM — my experience with this technique is very positive. Of course there is always MRI – but re-imbursement for breast MRI is complicated in Germany.
My first choice for women at high risk of breast cancer is definitely MRI but there can be reasons – such as pacemakers, allergic reactions to contrast or claustrophobia for switching to other modalities like Ti-CEM or now, the Mamma-CT.



The image quality is exceptional. Above image is an example of a breast CT with a small carcinoma right side 9h, size 11mm. Complicated case after reduction (see typical calcs) and scarring. The patient had already very painful compression experience and refused further mammogrqaphy. MRI was not possible (Pacemaker and Claustrophobia). Breast CT was carried out with 90ml i.v. contrast. Scan time 12 seconds. Image interpretation is no problem for radiologists with experience of 3D imaging, e.g. CT or MRI.

Q *Now that you've mentioned it, let's turn to the new CT.*

Let me be upfront —the system and its potential caught my attention right from the beginning. For me it is nothing short of a real, ground-breaking innovation in breast diagnostics, and incorporates the best aspects of all the other modalities we've had available to us so far. Not only does the new system combine a high comfort for the woman being examined with astonishing image quality, but it also does this in a very short examination time. The data speak for themselves: 7000 - 12000 projections per breast in 0.15mm isotropic 3D resolution in a maximum scan-time of 12 seconds. The whole procedure (for both breasts) is carried out in less than five minutes, including contrast media administration. On top of all this, and thanks to the extremey high performance of the photon-counting detector, the average radiation dose is comparable to that of a normal mammogram.

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And although our system is only the fourth installation in

the world, there have been absolutely no signs of "*start of series*" hitches or any teething troubles. The system has been robust, stable and reliable ever since its installation which was completed in mid-April. After all technical controls and regulatory compliance aspects were verified, we actually started scanning and examining patients in May 2020. The whole set-up process went extremely smoothly, since in principle it is "plug and play" where all primary reconstructions of the 3D-dataset are carried out on the machine's software and the DICOM headers and images are transferred automatically. We have a high-tech PACS with Syngo-Via, so it is no problem at all to deal with the large amount of data the machine produces (... by the way up to 4 Gigabyte per patient…).

In fact the most difficult thing was to get my (very motivated) mammo-technicians used to, and comfortable with, what was for them a completely new way of breast imaging and also to determine the optimal positioning routine for the patients to get the best image quality as possible for every case. But with the help of the AB-CT company, a few volunteers and some intensive learning sessions, we were able to examine our first real patient after only four days.

Right away, we were astonished at the quality of even the very first images we acquired. For anyone with experience of multi-modality imaging, it is quite easy to interpret the images so there was no problem for me and my colleagues. In practice, the radiologist is completely free to select whatever view he/she wants to look at — so even for those who are more familiar with fixed views such as Mediolateral Oblique (MLO) or Cranio Caudal (CC) and would prefer to see these views, the system can easily provide those multiplanar reconstructions (MPRs).

Q *And now what about the performance of the new system in clinical routine?*

I am not exaggerating when I say that from my point of view the performance of the Mamma-CT system is simply breath-taking. With every case, the image quality is like something out of science fiction. But let me describe our experience with the system.

In practice, the whole procedure is straightforward, fast and robust. During the first month we started very prudently and blocked 60 min. appointments in our planning schedule two days a week – so we had a throughput of 8-10 patients a week. Now we've speeded up a bit with 30 min. slots per patient for 3 – 4 days a week. We have now accumulated 500 examined patients. That may not sound all that impressive, but you must remember that for the moment we carry this out as an add-on to what is already a very busy practice. For the upcoming few months we are completely booked out for Mamma-CT and see the numbers steadily increasing. Nearly 90 % of the cases are quite complicated, have a long history of surgery/treatment or a high density/mastopathy issue.

As we build up our experience, we have come across some cases where the primary diagnosis might have been possible with conventional imaging, but where the real extent of the disease was only detectable with the breast CT. In the first weeks I even had some difficult cases with multifocal carcinomas or complications of implants but which were easily handled by the new system.

Because there is no longer a problem of tissue superimposition, the problem of dense breasts completely disappears with the new technique. Thanks to the very short scan time, and the fact that the system is very comfortable for the patient we have had almost no problems with movement artifacts and consequent reduced image quality. I am used to working multimodally — for example comparing mammos with MRI and/or tomos etc., but it is not that easy comparing priors with the CT-images and it can take at least 10 minutes to work out a case completely. In future it will definitely be a challenge comparing current and prior CT-examinations. It is not like reading mammos – more like reading tomos or even a complex chest CT for example. As the Mamma-CT modality is new, I put great emphasis on informing my patients completely and in detail about the procedure, but the examination itself is not a big deal for most patients.

In Germany the regulations mean that we must have a medical physicist available to check our CT-systems, including the monitoring of radiation dosages. In doing this with the new breast CT system, our medical physicist was astonished that the radiation level during normal operation was equivalent to that of a routine MLO and CC mammogram. The design of the system is such that no scattered radiation can reach the patient.

In principle, the new scanner could be used simply as a 3D-mammo-system, generating, in a very short examination time high-resolution 3D-images of the breast with no risk of tissue superimpositions, even in dense breast. However the additional use of standard contrast agents raises the technique from a purely morphological modality to one also providing functional information.

For me it is thus very close to a "one-stop shop" in that in a single examination it provides more reliable data and information than any other machine on the market. Now that I have used it for a few months, I am confident that the sensitivity and specificity are the highest obtainable in one exam procedure, especially when using contrast-media and all this independent of the breast density.

As if this current performance of the system isn't already impressive, the potential of possible future developments is breath-taking — iterative reconstruction

Medizinisches Versorgungszentrum
Prof. Dr. Uhlenbrock und Partner

Technical specifications

X-RAY TUBE

Focal spot size: 0.3 (IEC 60336)
Tube voltage: 60 kV
Tube current: 5-125 mA
Power: up to 7.5 kW
Filtration: 3 mm Al (equivalent)

SCAN

Spiral cone-beam CT scan
Up to 2000 projections/360°
Recording time 7-12s/scan
Extremely low dose
WITHOUT chest compression

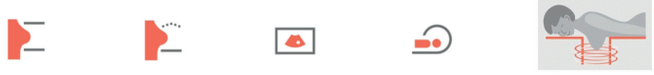
DETECTOR

Type: Photon-counting detector (direct conversion)
Sensor: CdTe, 0.75 mm thick
Pixel size: (0.1 mm)²
Detector area: about 280 x 50 mm²
Frame rate: up to 1000 Hz
Extremely high resolution
With the highest sensitivity

RECONSTRUCTION

Isotropic and high-resolution display
Size of the measuring field: Ø 200 mm x 160 mm
Voxel size: (0.15 mm)³
Filtered back-projection reconstruction algorithm

Technical specifications of the nu:view Mamma-CT system



	Mammography	Tomosynthesis	Sonography	MRI	Mamma CT
3D imaging	X	+	+	+	+
Superimposition	X	+	+	+	+
Contrast media	+	X	X	+	+
Microcalcification	+	+	X	X	++
Comfort	XX	XX	+	X	++

Performance characteristics of conventional breast imaging modalities compared with the nu:view Mamma- CT system

and spectral 3D-CT of the breast are entirely feasible next steps and would bring a whole new dimension to breast diagnostics.

Q *In practice, what criteria do you use to decide which women should be examined using the new system and which by classical mammography?*

As a clinician with experience of leading programs in the field of German mammography screening, I am of course well aware of all the pros and cons of conventional imaging and I use this experience to assign the appropriate imaging modality to the patient. So, if I have an "easy breast" case, that is one with a density category of A-B and with prior exams available for comparison, then I would be happy to opt for a relatively straightforward tomosynthesis examination. In such a case there is no reason to go for a CT, far less for MRI and ultrasound, although these techniques have for sure their own place in diagnostics.

However, some women experience significant pain from compression during mammography or tomosynthesis. Others are aware of the issue of dense breasts (perhaps from the harassed look of their radiologist trying desperately to get a clue out of their images). There is also a growing number of women with silicone-implants, which are difficult to examine. For these and other reasons such women refuse the standard mammo or tomo procedures. MRI may also be contraindicated for several reasons including claustrophobia or an allergic diathesis against the gadolinium contrast medium. With all these reasons, there are at least 3-4 out of 10 women, who will choose Mamma-CT rather than conventional imaging — and will even pay for that examination out of their own pocket. This in itself vindicates the rationale behind the development of this machine which was not just to achieve perfect imaging quality but also to satisfy the needs of the patients. This combination in my opinion is the cornerstone of its success.

(By the way I just mentioned women with implants — I am convinced that breast CT will become the reference method of choice for women with silicone implants. Perfect 3D-imaging of all structures can be obtained – cutis, pectoralis, breast-tissue and implants without any compression and without any risk of damaging or rupturing the implants)

> "... At least 99% of the women we have examined in the system are absolutely happy with it because of its speed and lack of compression

At least 99% of the women we have examined in the system are absolutely happy with it because of its speed and lack of compression. Most of them have already had experiences of the other modalities so their choice of the breast CT is deliberate and informed.

The pain associated with compression of the breast is one main reason women drop out of mammography or mammo-screening programs. Up to 15 % of the women undergoing mammography report the pain as " very strong" – so it's no surprise that most screening programs do not reach anywhere near 90% participation-rate.

Q *So, all in all, how do you sum up your impression so far of the nu:view system? How do you see the future ?*

To be frank, in my opinion most colleagues in the field are either unaware of the nu:view system or completely underestimate its potential. They may well know all about the performance characteristics of the various imaging modalities in breast diagnostics - but they completely ignore the needs and wishes of the women being examined. The old story is true– if 40 years ago someone had forced men to put their sensitive parts into a machine and squeezed – such a machine would not have lasted long on the market. Seriously however, if you take the positive reaction of the women to the short, pain-free examination on the one hand with the high sensitivity and specificity on the other, the combination makes the future of the new system look very promising.

As for the future more generally, I believe radiology will have to become more and more focussed on every individual patient and each clinical question, for example via risk-based stratification of breast screening. In future, the central role of the radiologist will be to identify the most appropriate, accurate and rapid diagnostic tool which best fits each case. The resulting images may well be detected and flagged with the help of Artificial Intelligence. But the interpretation of the findings, the establishment of the correct diagnosis and especially the communication of this to the patients and referring colleagues will remain a main part of the radiologist's job in future. So when we talk about the future of AI and radiology we are in fact talking about a more intelligent use of resources that are becoming more and more rare – radiologists! In mammo-screening in particular I foresee the second reader will be AI-based within the next 10 years. In other modalities we will see such a disruptive innovation even earlier. It is like the use of smartphones – there is no way back. Even now.