The world's first MAGNETOM Avanto T-class featuring *syngo* TimCT has been installed at the University Hospital Essen.

A Moving Reality

Scanning with continuous table movement and temporally-resolved subsecond measurements are two innovations that bring dynamic to magnetic resonance. *Medical Solutions* talked to experts in Essen, Germany, and Chicago and Los Angeles, USA, about their experiences with *syngo* TimCT and *syngo* TWIST. One solid vote is already in: Both applications provide new, additional image information with a simplified workflow.

By Matthias Manych

Not only are physicians able to see more thanks to *syngo* TimCT and *syngo* TWIST – technologists also benefit from the simplified workflow.

When the first whole-body magnetic resonance angiographies (MRA) were developed, each step had to be performed one by one, manually. The first step was to unlock and manually move the magnetic resonance imaging (MRI) system's table through the system. The idea behind this was conceived in 1999, reports Jörg Barkhausen, MD, Vice Chairman of the Department of Diagnostic and Interventional Radiology and Neuroradiology at the University Hospital Essen: "At that time, we had received a new scanner, the MAGNETOM® Sonata. The new system drastically reduced scan time without losing spatial resolution. Our reasoning was that if we were able to measure one station in the body this quickly, it should be possible to combine many stations, one after the other during one examination – all we had to do was move the patient through the magnet fast enough."

From AngioSURF to the *syngo* TimCT Technology

This ingenious innovation was developed in Essen. In 2000, a tabletop positioned on rollers, combined with new coils close to the body to enable high-image quality, was also introduced. However, manual work was still necessary; the tabletop needed to be moved by a person. "That was the hour when high-resolution whole-body images were born," Barkhausen proudly remembers. The combination, well noted for its ingenuity, was developed with Harald H. Quick, Chief Physicist of the Department of Diagnostic and Interventional Radiology and Neuroradiology. It was first marketed by the institute under the name of AngioSURF. While the tabletop was reminiscent of a surfboard, SURF was the apt acronym for 'System for Unlimited Rolling Field of View'.

The further development of the project demonstrates how university and industry collaborators can work together to promote one another. The work on AngioSURF raised Siemens interest. Siemens developed Tim® (Total imaging matrix), which in turn helped the project in Essen gain momentum. Finally, at the end of 2006, *syngo*® TimCT – Continuous Table move with Tim – was introduced as a completely integrated solution. Instead of a table that had to be moved manually, the completely new application is driven intelligently and automatically through the MAGNETOM magnetic resonance (MR) scanner.

Movement – Almost a Friend

In December 2006, the world premier of the scanner was held at the University Hospital Essen. The first T-class MAGNETOM system featuring *syngo* TimCT was put into clinical operation. It was the beginning of a new era in MR image acquisition. Movement, which was the previous enemy of MRI, was now approaching friend status. "With *syngo* TimCT, we are using movement for something completely new. The patient's body is automatically moved through a field of view via continuous table movement. There are no gaps or seams," explains Barkhausen. While the 50-centimeter-large field of view moves continuously, Tim acquires images with high spatial resolution.
Physicists and radiologists alike are quite satisfied with the progress made so far. Now, the image quality is comparable to a multistation protocol. However, it is now acquired in only a single, continuous table movement.

Simplified Workflow

What does the daily routine now look like? Again, Barkhausen is able to provide a positive report: "Workflow has been greatly simplified. Previously, we needed up to twelve work steps – from patient positioning on the MRI table to data acquisition. But today we only need six steps." On the one hand, this minimizes possible error sources. On the other hand, the continuous movement of the table is much more comfortable for the patient than the 'stop-and-go' of the past. The simplified workflow will also enable more patient examinations per day. Currently, *syngo* TimCT is used for vascular examinations. In Essen, the pelvic and leg vessels of approximately 20 patients who predominantly suffer from peripheral arterial occlusions have already been examined. Mr. J., a patient suffering from claudicatio intermittens, lies fully prepared on the MRI table. The technologist kindly gives the breathing commands and informs Mr. J. that the contrast medium will now be injected. At the same time, the measurement begins; initially, however, without table movement. "We know that it takes about 19 seconds for the contrast medium to pass through the arm artery of this patient," explains Barkhausen. Then, the table begins to move automatically at 18 millimeters per second for continuous data acquisition. After that, the image is reconstructed from the aortic arch down to the vessels of the lower leg, and accurately displays the extent of peripheral arterial occlusion.
Siemens plans to use the *syngo* TimCT method as soon as possible for diagnosing additional diseases, such as tumors, or for localizing metastases. The combination of *syngo* TimCT and MRI systems with shorter magnets is also very promising and should facilitate the examination of claustrophobic patients and children.

"The patient's body is automatically moved through a field of view via continuous table movement. There are no gaps or seams."

Jörg Barkhausen, MD,
Vice Chairman, Institute for Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Germany

Into the Fourth Dimension with *syngo* TWIST

Although *syngo* TimCT already provides movement in MRA, an additional innovation makes MR truly dynamic. "You can see the contrast medium arriving, the arteries of the lungs are well contrasted, and now it has already moved to the veins of the lungs. While we have optimal contrast in the aorta, the contrast medium has already left the pulmonary arteries." What Barkhausen reports at the operating console, in a voice closely resembling that of a sports reporter, is the result of *syngo* TWIST (Time-resolved Angiography with Interleaved Stochastic Trajectories). For the first time, it is possible to com-

bine temporal information with high spatial accuracy and travel on the path of dynamic MRA. "This brings us close to reality," emphasizes Barkhausen. In combination with contrast medium, it is possible to measure vascular hemodynamics or perfusion in the lungs or kidneys, as well as vascular pathologies such as peripheral arterial occlusion or arteriovenous malformations. This advantage can be used when examining the carotid arteries – where the time frame is only ten to 15 seconds – or for shunts in the vicinity of the heart.

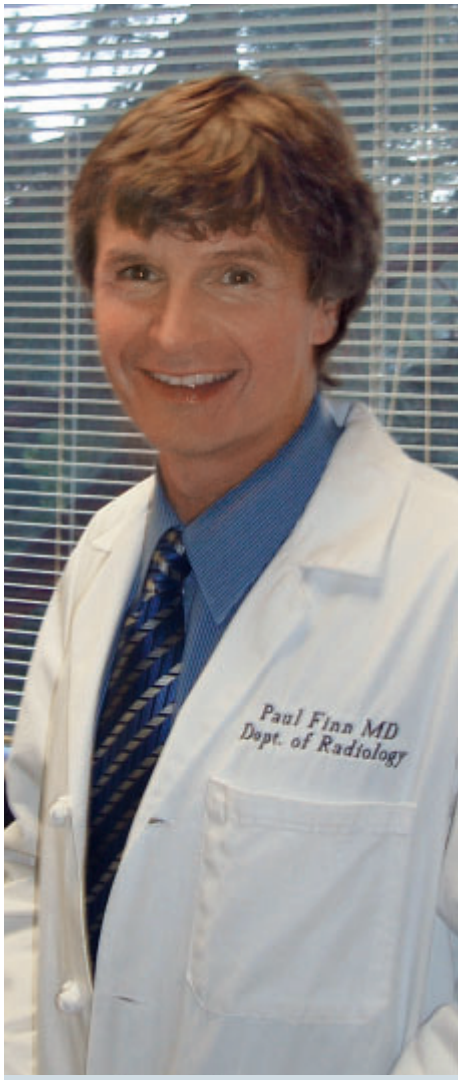
James Carr, Director of Cardiovascular Imaging at the Northwestern University Medical School, Chicago, IL, USA, adds, "When we combine *syngo* TWIST with other strategies for fast measurements, for example, parallel imaging, we are able to generate MRI angiography at a speed that is comparable to digital subtraction angiography (DSA). This technology provides us with more flexibility; we can adjust imaging to the disease." If extremely fast blood flow has to be displayed, the acquisition speed of *syngo* TWIST measurements can be adjusted accordingly.

Advantages for the Radiological Routine

The experiences made to date with *syngo* TWIST convince the experts. This new type of dynamic imaging is easy to implement and performance-oriented. For J. Paul Finn, MD, Head of Diagnostic Cardiovascular Imaging and Director of Magnetic Resonance Research at the David Geffen School of Medicine, University of California, Los Angeles, USA, it is "ready for prime time."

The technology simplifies workflow and increases safety. Bolus timing can now simply be ignored. Instead, the measurement is started the moment contrast medium is injected, thus preventing potential timing errors. After the datasets have been continuously measured, the radiologist is able to evaluate images of the arteries much easier without venous flow contamination.

The physicians in Chicago and Los Angeles use *syngo* TWIST predominantly as an additional method to conventional 3D MRA. "Using the functional information from *syngo* TWIST, we complement the detailed anatomical information that we obtain from static examinations," says Finn. Temporal resolution can also be used to easily and reliably determine the contrast medium timing for subsequent static MRA.



"Using the functional information from *syngo* TWIST, we complement the detailed anatomical information that we obtain from static examinations."

J. Paul Finn, MD,
Head of Diagnostic Cardiovascular Imaging,
Director of Magnetic Resonance Research,
David Geffen School of Medicine,
University of California, Los Angeles, USA

The Future of MR Angiography

To date, MRA outside the hospital environment is not widespread. However, with the innovations – *syngo* TimCT and *syngo* TWIST – it will also be suitable for radiologists in private practices. Acceptance is sure to increase, especially with *syngo* TWIST, says Finn. Carr also emphasizes, "It will become the daily bread for radiology."

How does the future for MRA look? The possibility to combine continuous table movement exams and dynamic MRA will be a fascinating application for medical specialists. Currently, however, the techniques are still too different. However, the twinkle in Jörg Barkhausen's eyes gives away his curiosity for the next evolutionary leaps in whole-body MRA. After all, the radiologist knows how fast MRI is developing.

Matthias Manych, *a biologist, is a freelance scientific journalist and editor specialized in the fields of medicine, biological sciences, and ecology. He works for various newspapers and trade publications.*