

# Image Fusion Applications: Precision Medicine for Structural Heart Diseases

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Modern catheter technology allows patients with defective heart valves or other types of structural heart disease to be treated successfully, even at an advanced age. The best possible ultrasound diagnostics before and during procedures enable optimum interventions while also reducing radiation dose and supporting maximum safety.

Text: Philipp Grätzel von Grätz

**W**hen Olaf Göing, MD, Head of Cardiology at Sana Klinikum Lichtenberg in Berlin, performs a mitral clip procedure on a patient with mitral valve insufficiency to repair the leaking valve, he leaves nothing to chance: Starting in the right atrium, he leads the instruments through the inter-atrial septum and into the left atrium at precisely the right position for an optimum mitral valve procedure. Passing the instruments along a guidewire toward the roof of the atrium, he keeps some distance from the roof and the left atrial appendage to avoid causing any damage. Once in the middle of the atrium, he angles the instruments and navigates them through the center of the mitral valve toward the left ventricle. Throughout the procedure, he takes care not to damage the neighboring aorta. Finally, he opens the clips to grasp the mitral valve leaflets. If everything works as planned, the mitral valve will close tightly again – and the 75-year-old grandmother, who

used to be so short of breath she could barely walk, can go back to enjoying everyday life with her grandchildren.

## Interventional valve procedures for people of all ages

In Lichtenberg, catheter-guided mitral valve procedures have become an important additional mainstay of interventional cardiology. Every year, Göing and his colleagues treat around 5,000 cardiology patients with all types of indication on an inpatient basis, in addition to around 4,500 outpatient cases. “These numbers have been increasing for years and will continue to rise,” says the cardiologist. “The population is aging, and the capabilities we have to treat patients with typical age-related cardiological diseases in a minimally invasive manner are constantly improving.”





Intraprocedural image fusion applications enable minimally invasive therapy of defective heart valves.

This applies to cardiac arrhythmias such as atrial fibrillation, where the rates of diagnosis are steadily improving. Since the publication of the CASTLE-AF trial in summer 2017, catheter-guided procedures to treat atrial fibrillation is gaining increasingly acceptance as a further method of improving heart function. It also applies to structural heart disease, and valve defects especially, where catheter-guided procedures have been perfected to the extent that symptom-relieving interventions can now be offered even to patients for whom a surgical valve operation is out of the question.

This is most evident in aortic valve procedures. Transcatheter aortic valve implantation (TAVI) is now used to treat over 15,000 patients a year in Germany, almost all of whom would not have been eligible for heart surgery. Mitral valve defects are rarer, but the number of corresponding interventions is also on the rise. "We'll soon also see clip repairs on the tricuspid valve in the right

heart," says Göing. All of these patients are elderly; many of them aged between 75 and 80, and some even older.

## High-performance imaging is essential

Unlike aortic valve interventions, procedures to clip the mitral and tricuspid valves can be performed even without a cardiac surgeon present – following coordination within the surgical team. Sana Klinikum Lichtenberg has realized it can help greater numbers of seriously ill patients than it originally thought and is therefore investing in imaging technology – a basic prerequisite for complex interventions of this kind. "Every heart is slightly different," says Göing. "To reach our target, we need the best possible information about the anatomy and geometry of the heart; not only before the intervention but also in real time during the procedure itself."

For this, the cardiologists in Lichtenberg rely entirely on echocardiography using the ACUSON SC2000 ultrasound system from Siemens Healthineers. To allow optimum planning of each procedure, the valves and chambers of the heart are measured as precisely as possible in two and three dimensions prior to the intervention: "We need to see what exactly is wrong with the valves. Is it a problem with the posterior or anterior leaflet? Have the affected leaflets become too short or stiff? This is vital information that we must have at our disposal."

During the procedure a transesophageal echocardiography (TEE) probe is inserted into the esophagus in order to deliver three-dimensional ultrasound information about cardiac anatomy and heart valve function in real time. In a technique known as *syngo TrueFusion*, this detail is combined with live fluoroscopy from the Artis angiography system so that the cardiologist can judge the position of the instruments not only within a fluoroscopic 2D projection but also embedded within an echocardiograph of the heart's 3D anatomy.

## Faster interventions with reduced radiation exposure via high-end echocardiography

Göing is convinced that this method pays dividends for patients: "High-end echocardiography makes our interventions faster and ultimately reduces exposure to radiation. Thanks to more-accurate navigation, it also reduces complications during the procedure. And it genuinely helps us to achieve the desired clinical outcome thanks to enhanced strategic planning of the intervention."

Giving a concrete example, he explains that intraprocedural fusion imaging reduces the risk of injury to key heart structures or adjoining blood vessels: "For example, there's a guidewire that we need to place inside the vena pulmonalis. If we accidentally insert it into the left atrial appendage, there's a serious risk of perforation," Göing says. Fusion imaging also helps the cardiologist to guide the instruments through the interatrial septum and into the left atrium at precisely the right position for an optimum clip procedure.

Olaf Göing, MD, Head of  
Cardiology at Sana Klinikum  
Lichtenberg in Berlin  
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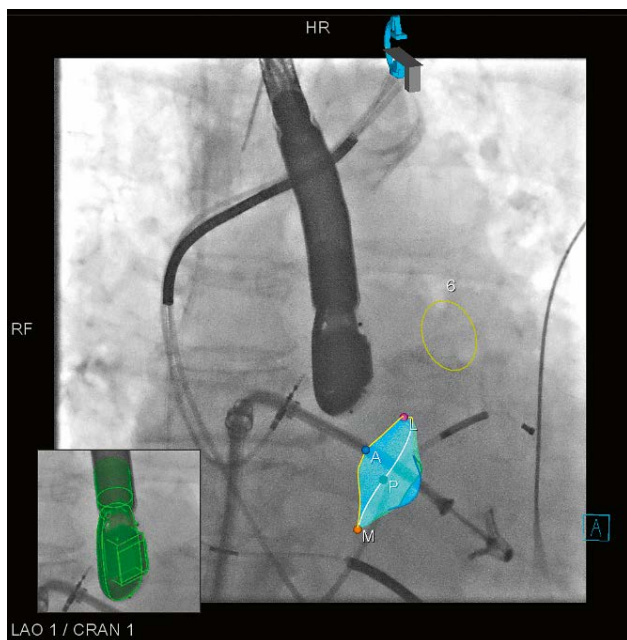
### *syngo TrueFusion*

- Automated co-registration of TEE and angiography with artificial intelligence of eSie Sync
- Efficient workflow through export of fusion landmarks directly from the ACUSON SC2000 ultrasound system
- Scope for contrast and fluoro time-savings

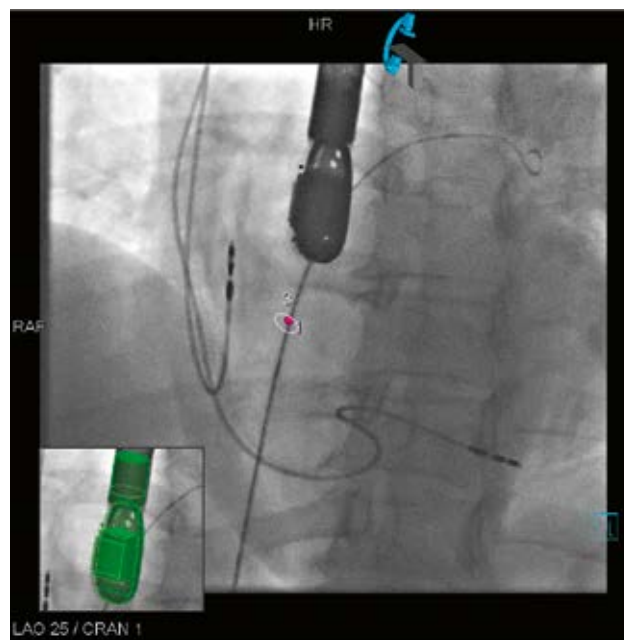
### Artis zee with PURE

In-room control of relevant functionalities via context-sensitive on-screen menu





Fusion of eSie Valves model for optimal orientation of the clip device.



Fused TEE landmarks of PFO to guide the intervention.

## Broad potential for applications beyond the mitral valve

The benefits of fusion imaging that combines high-end echocardiography and angiography are currently at their most evident in mitral valve clipping, but this is not the only area of application. In the future, Göing believes that real-time fusion imaging will also be indispensable in clipping procedures on the tricuspid valve: "The overall geometry of the right ventricle is totally different, so we'll need to learn everything from scratch. Live TEE will provide valuable support for this process."

Image fusion could, Göing says, also be of assistance in other procedures, such as left atrial appendage closure (LAAC) in cases of atrial fibrillation: "Our aim

is to ensure that this method is available whenever it's needed. It could also be an effective training tool for less-experienced colleagues."

Nowadays, image fusion can already be activated quickly during a procedure, and the process is set to become even faster in the future. Moreover, although it is not yet possible to adapt three-dimensional echocardiography datasets to the movement of a beating heart, this problem will likely be overcome at some point. Cardiologists will then be able to maneuver their instruments inside patients' hearts even more safely – and help older people, in particular, achieve greater quality of life. Göing sees this as nothing short of his duty: "If an 80-year-old grandmother is still at the heart of the family and can no longer breathe easily, then it's our job to ensure she can still play with her grandchildren. That's how I see it." ●

### ACUSON SC2000 PRIME with real-time True Volume TEE and eSie Valves

Comprehensive analysis of valve function

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

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