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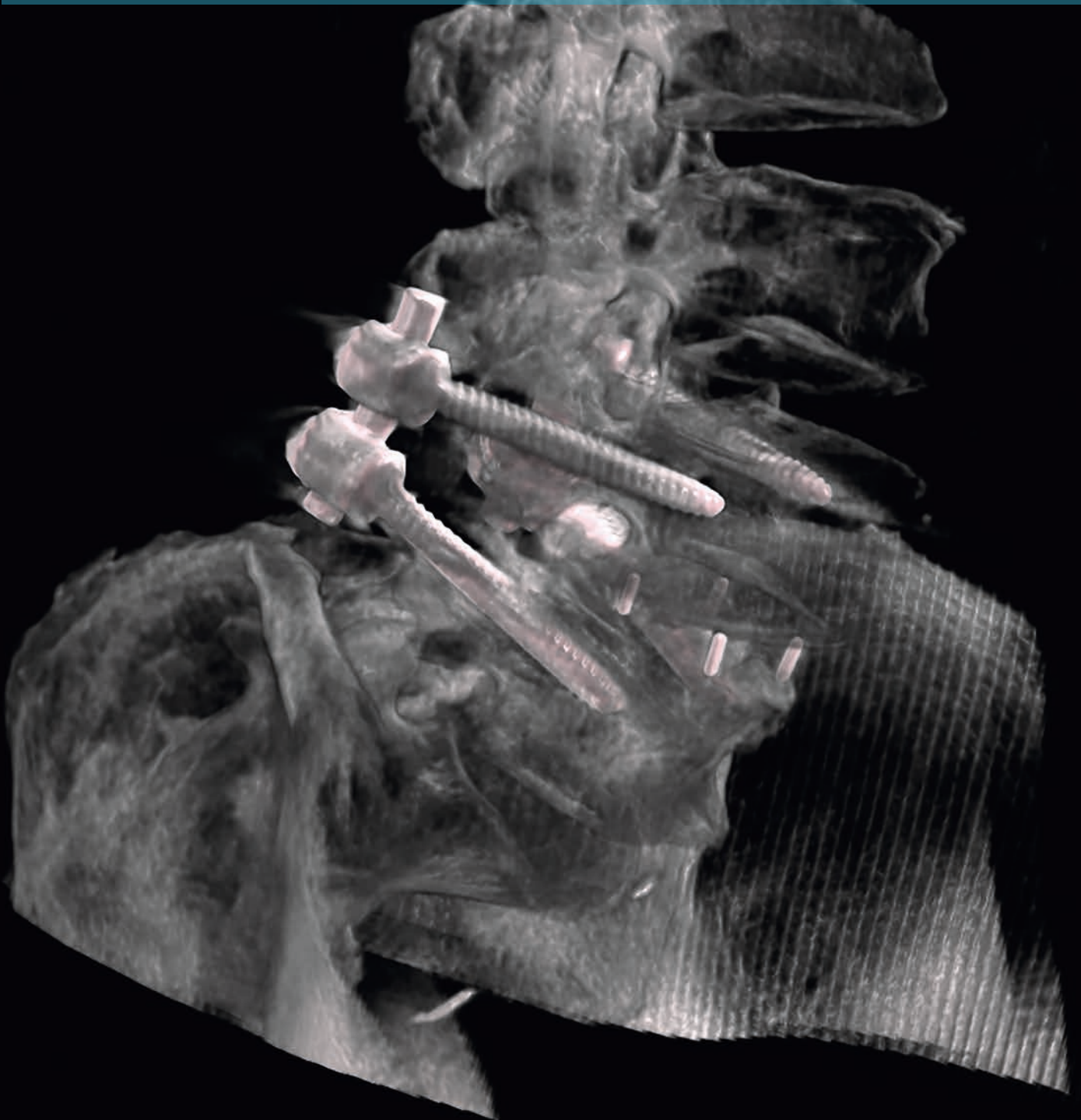
Feels right  
at first sight

[siemens.com/spine](https://www.siemens.com/spine)

Speed. Precision.  
No repetition.

High-end Imaging in Spine Surgery.

Speed. Precision. No re



# petition.

## Siemens Healthcare in Spine Surgery

Almost all discussions of modern spinal surgery will at some point lead to the concept of improved quality management in open and minimally invasive approaches. The common goal of institutions and surgeons as well as patients is the best achievable outcome along with short OR times and reduced hospital stay.

Minimal invasiveness is a trend that is increasingly finding its way into spinal surgery. It can lead to less blood loss, faster rehabilitation as well as less pain and scarring. However, it may also mean longer OR time, more radiation dose, and less precision. What is needed are the skills and the technology to do it right. That way, minimally invasive procedures can be **fast, precise, and reduce the amount of complications and readmissions**. The right imaging technology can speed up workflows and enable procedures that simply were not possible before – and that's true both for minimally invasive and open approaches.

Siemens Healthcare supports you with technology that feels right at first sight, adapting the highly successful concept of the **hybrid OR** to spinal surgery: a powerful working environment with a fixed C-arm that offers the best possible support. From integration of pre-operative data to intra-operative guidance and quality control, the robot-supported imaging system Artis zeego offers high-resolution 2D and 3D imaging, ultrafast image acquisition, an extra large Field of View, and navigation integration – all in one room and at low dose.

Make your decisions with confidence and handle complex or difficult cases while increasing patient safety and reducing the number of secondary surgeries. And that is spine surgery done right.

**Siemens Healthcare – High-end Imaging in Spine Surgery.**

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# Fast operations and faster recovery for patients

When talking about speed and our solutions in spine surgery, there are at least two stories to tell: one about the advantages of minimally invasive surgery in general and one about the imaging technology that helps you reach the next level both in minimally invasive and open procedures.

Artis zeego delivers advanced technology for **additional speed** in spinal workflows and procedures.

## The impact of spine surgery

For patients, spine surgery has a big impact. It is connected with an extended hospital stay, scarring, post-operative pain, pain medication, and lengthy recovery. At the same time, it puts a strain on the treating institution: open spine procedures mean long OR times, risk of infections and complications, and lengthy hospital stays after surgery. Minimally invasive surgery can bring advantages in all of these areas.<sup>1</sup>

## Advantages and limitations of minimally invasive procedures

First and foremost, minimally invasive procedures mean less trauma to the muscles and soft tissue. This implies not only faster recovery for patients, but also less risk of muscle damage, reduced blood loss, as well as lower infection and complication rates.<sup>2</sup> On the other hand, minimally invasive surgery can also mean more radiation dose and longer OR times since natural vision and tactile sense are impaired. With the right technology, however, these limitations can be overcome. Once surgeons are proficient, minimally invasive surgery can therefore mean shorter OR times.

Dr. Sohei Ebara of Shonan Fujisawa Tokushukai Hospital in Japan, for example, says that operating time has been cut almost in half since 2012, when he installed a hybrid OR equipped with Artis zeego – the first hybrid OR worldwide solely dedicated to spine surgery.

## The right tools

As natural 3D vision and access to the spine are impaired in minimally invasive surgery, high-end technology is necessary in order to safeguard optimal workflow and accurate results. For these purposes, the robot-supported fixed C-arm Artis zeego enables minimally invasive procedures even in challenging cases. It provides automation and speed, so that the imaging system is no longer an obstacle but speeds up procedures instead.

## Intra-operative 2D imaging

Apart from regular 2D images, the Automap function stores positions and projections from recorded fluoroscopy scenes. When the imaging system is not needed, it can be moved out of the way via tableside control. For intra-operative control and guidance, the surgeon can recall previously recorded references – and the C-arm automatically moves back

<sup>1</sup> See, for example: Khan NR, Clark AJ, Lee SL, et al. Surgical Outcomes for Minimally Invasive vs Open Transforaminal Lumbar Interbody Fusion: An Updated Systematic Review and Meta-analysis. *Neurosurgery*. 2015 Jul 24. [Epub ahead of print].

<sup>2</sup> See also Khan NR, Clark AJ, Lee SL, et al. In addition: Heiney J, Capobianco R, Cher D. A systematic review of minimally invasive sacroiliac joint fusion utilizing a lateral transarticular technique. *International Journal of Spine Surgery*. 2015; 9:40. doi: 10.14444/2040.

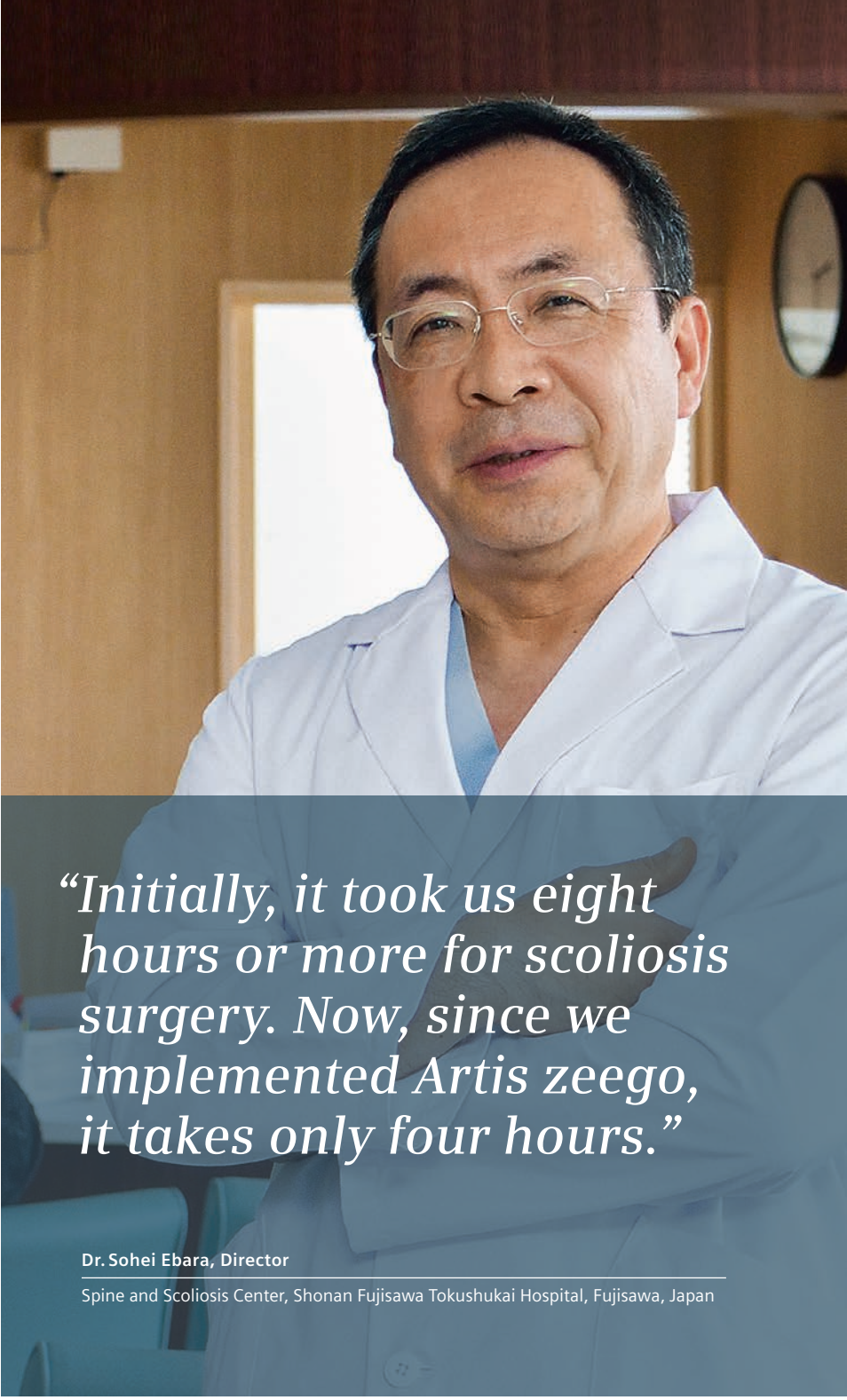
into the exact position within seconds, no manual repositioning needed. A large flat-panel detector allows a large Field of View (FOV) with all necessary information in one image instead of multiple fluoro shots. This means no more trial and error, reduced radiation exposure for patients and staff, and significantly faster workflows.

#### Ultrafast 3D imaging

In addition, Artis zeego offers extremely fast 3D imaging in almost any position. syngo DynaCT 3D image acquisition takes only 5 seconds, with a reconstruction time of 20 seconds. The integration of the system with the surgical table enables quick and collision-free movement along the patient. The ultrafast 3D acquisition not only speeds up your imaging workflows but also delivers outstanding image quality for exact surgical planning.

#### Intra-operative quality control

What's more, the imaging system can be used for quality management at the end of the procedure. Once the screws or implants are in place, Artis zeego lets you perform an immediate intra-operative syngo DynaCT scan – right in the OR. There is no more change of modalities, no more having to move the anesthetized patient to the CT, no more waiting time. Instead, you get immediate and confident quality control, fast workflows – and the possibility to make immediate adjustments.



*“Initially, it took us eight hours or more for scoliosis surgery. Now, since we implemented Artis zeego, it takes only four hours.”*

Dr. Sohei Ebara, Director

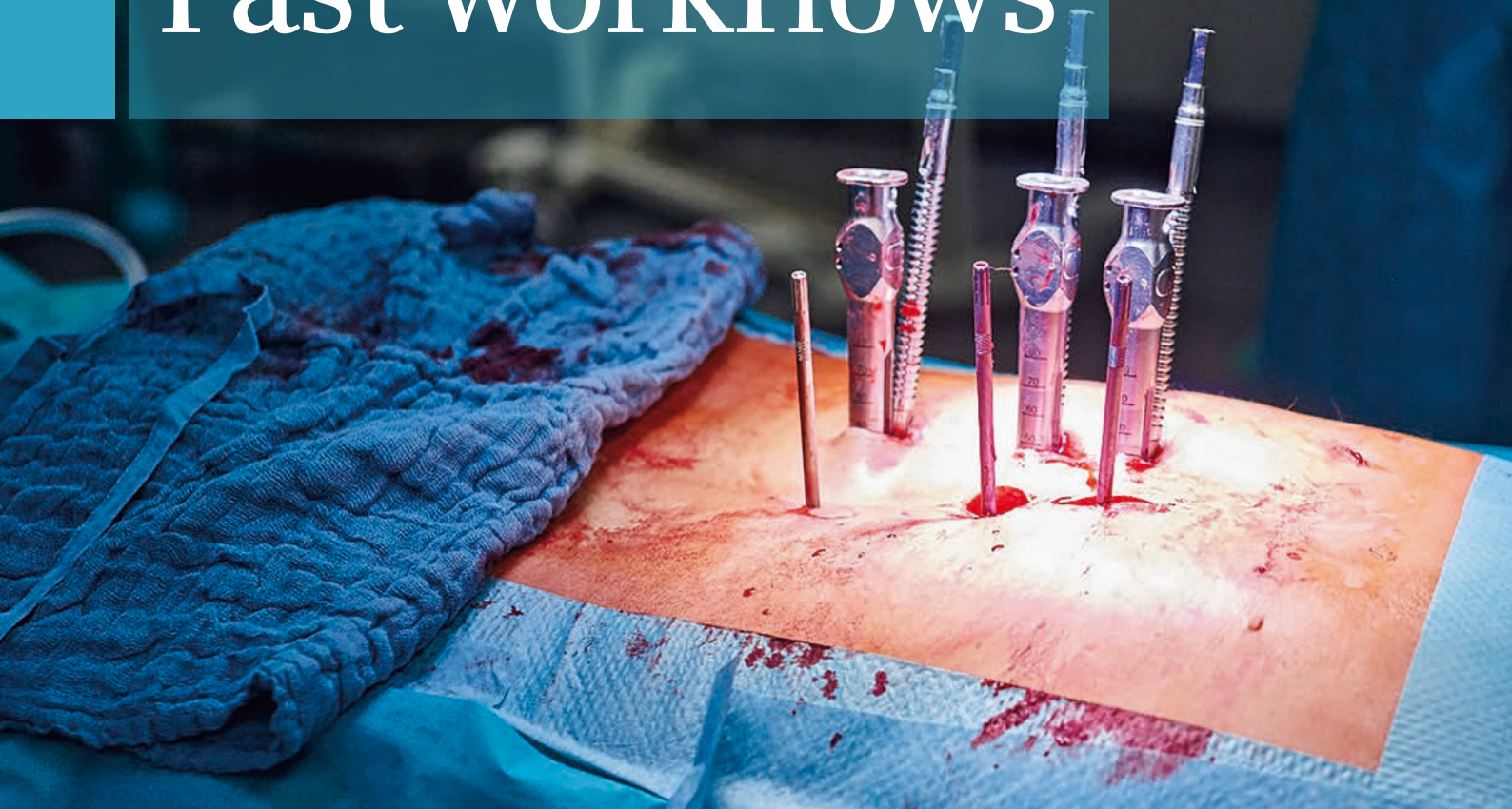
Spine and Scoliosis Center, Shonan Fujisawa Tokushukai Hospital, Fujisawa, Japan

#### At a glance:

- Substantial OR time reduction of up to 50% in scoliosis surgery
- Robot-supported C-arm easily and quickly moves into stored and predefined positions
- Ultrafast 3D image acquisition
- Time savings in intra-operative control: directly in the OR, without having to shuttle the patient to CT and back
- No more trial and error: quick and exact movements and imaging positions for reduced dose



# Fast workflows

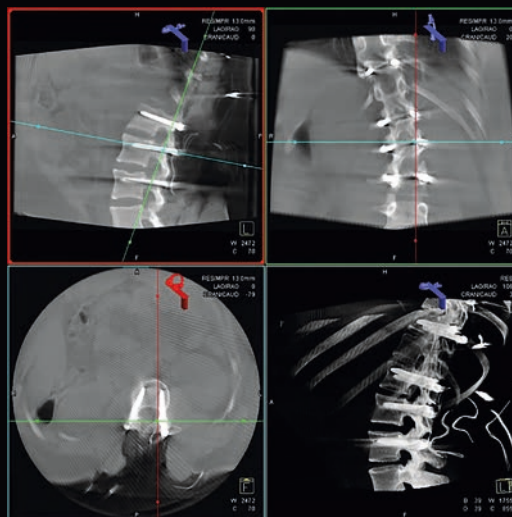


Courtesy:  
Ulm University Hospital,  
Ulm, Germany

## Ultrafast 3D image acquisition

3D image acquisition with syngo DynaCT takes only 5 seconds, with a reconstruction time of 20 seconds.

- Supports fast workflows with excellent image quality
- The imaging system is thus no longer an obstacle, but speeds up procedures instead



**Multiplanar reconstruction**  
supports quick decision making – multilevel spinal fusion with optimal intra-operative quality control

Courtesy:  
St. Luc University Hospital Brussels,  
Belgium



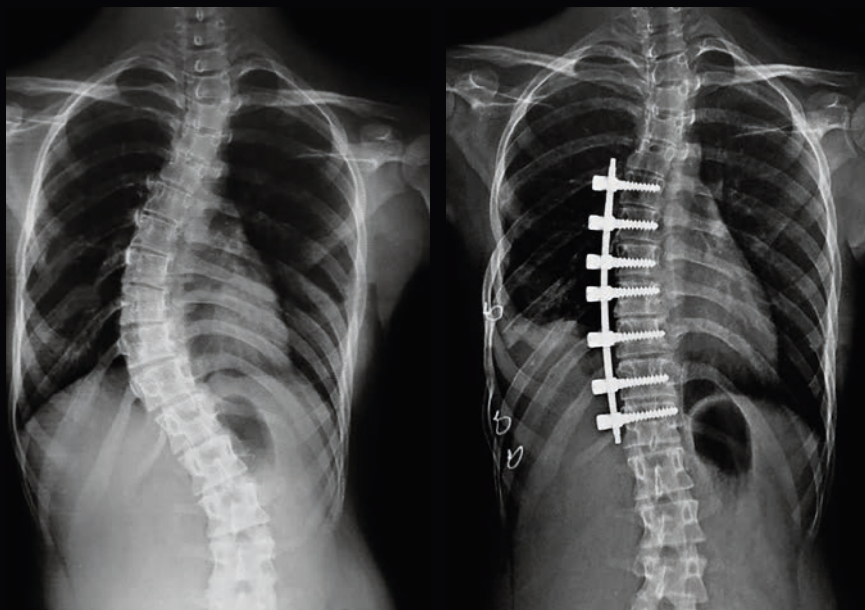
**Quick and comprehensive 3D image acquisition**  
of elongated deformations – whole region of interest in one image

Courtesy:  
Sahlgrenska Gothenburg,  
Sweden

# Making minimally invasive procedures fast



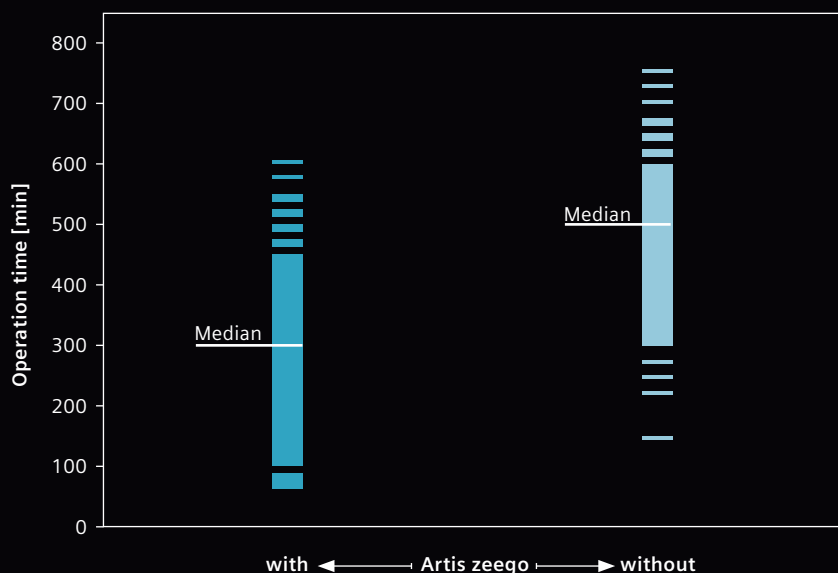
As natural vision is impaired in minimally invasive procedures, high-end imaging support is crucial for accurate results and fast workflows.



**Scoliosis before (left) and after (right) surgery –** large Field of View and image composition functionality deliver a complete overview for excellent planning and quality management



**Minimally invasive scoliosis surgery –** small incisions mean less pain, faster recovery, and better cosmetic results



## Decrease OR time

Scoliosis surgery – whether it's done open or minimally invasive – is challenging and takes time using a conventional workflow.

In a hybrid OR equipped with Artis zeego, operating time can be cut almost in half – even in challenging cases.

Faster surgeries are not only better for the patient but also bring economical value.





*“Since we installed Artis zeego, on which our navigation is now based, we had to revise only 3% of the screws intra-operatively. Post-operatively the revision rate was zero.”*

Christian Raftopoulos, MD, PhD, Department for Neurosurgery  
Cliniques Universitaires Saint-Luc Brussels, Belgium



# Better ability to handle complex cases



There are cases when spine surgery is especially challenging. In a hybrid OR equipped with Artis zeego, you can treat such cases with confidence – and even perform surgeries that were simply not possible before.

## Challenging patients and anatomies

Spinal procedures are challenging to begin with. There are, however, cases that make such procedures particularly difficult. Obese patients, for example, not only mean increased complications, blood loss, and operating times<sup>3</sup>, they also require imaging equipment that delivers appropriate tissue penetration. Surgeons also face challenges in spinal deformities, small fracture fragments, tumors, and in difficult-to-image areas such as the spinal junctions and in osteoporotic patients. In these situations, high-resolution visualization and patient access are crucial for accuracy and patient safety.

## Optimal guidance in complex cases

First, it's important to have a good overview. For this purpose, a large flat-panel detector offers a Field of View (FOV) of 5–7 vertebral bodies in 3D volumes. For larger deformities, when an even larger overview is needed, Large Volume *syngo* DynaCT delivers an FOV like no other modality. It can depict up to 10 vertebral bodies at once. In addition, Artis zeego lets you fuse pre-operative CT, MR (soft tissue), or PET-CT (tumor) data with fluoroscopy to combine all necessary information in one 3D image – for better planning and control before and after surgery. Image fusion can add valuable information, e.g., for precise tumor resection in order to spare healthy tissue and avoiding crucial anatomy such as vessels.

## High-quality images no matter what

Precision is also warranted by the exceptionally high image quality delivered by Artis zeego. This quality is maintained even in obese patients – thanks to a strong power generator that ensures adequate tissue penetration. For visualization of particularly challenging anatomy such as the smallest fracture fragments, *syngo* DynaCT Micro lets you reach a spatial resolution of 0.1 mm. Additionally, dedicated metal artifact reduction software offers clear visualization of implanted screws for optimal quality assurance.

## Full flexibility and integration of navigation

For optimal patient positioning and access during complex procedures, the robot-supported imaging system and table integration give surgeons full flexibility. The system can easily be controlled by the surgeon and seamlessly moves into park positions when not needed. Furthermore, Artis zeego can be integrated with a variety of navigation systems (e.g., Brainlab or Medtronic) – which not only reduces the need for excessive fluoroscopy in the OR, but also delivers the highest precision for exact placement of screws.

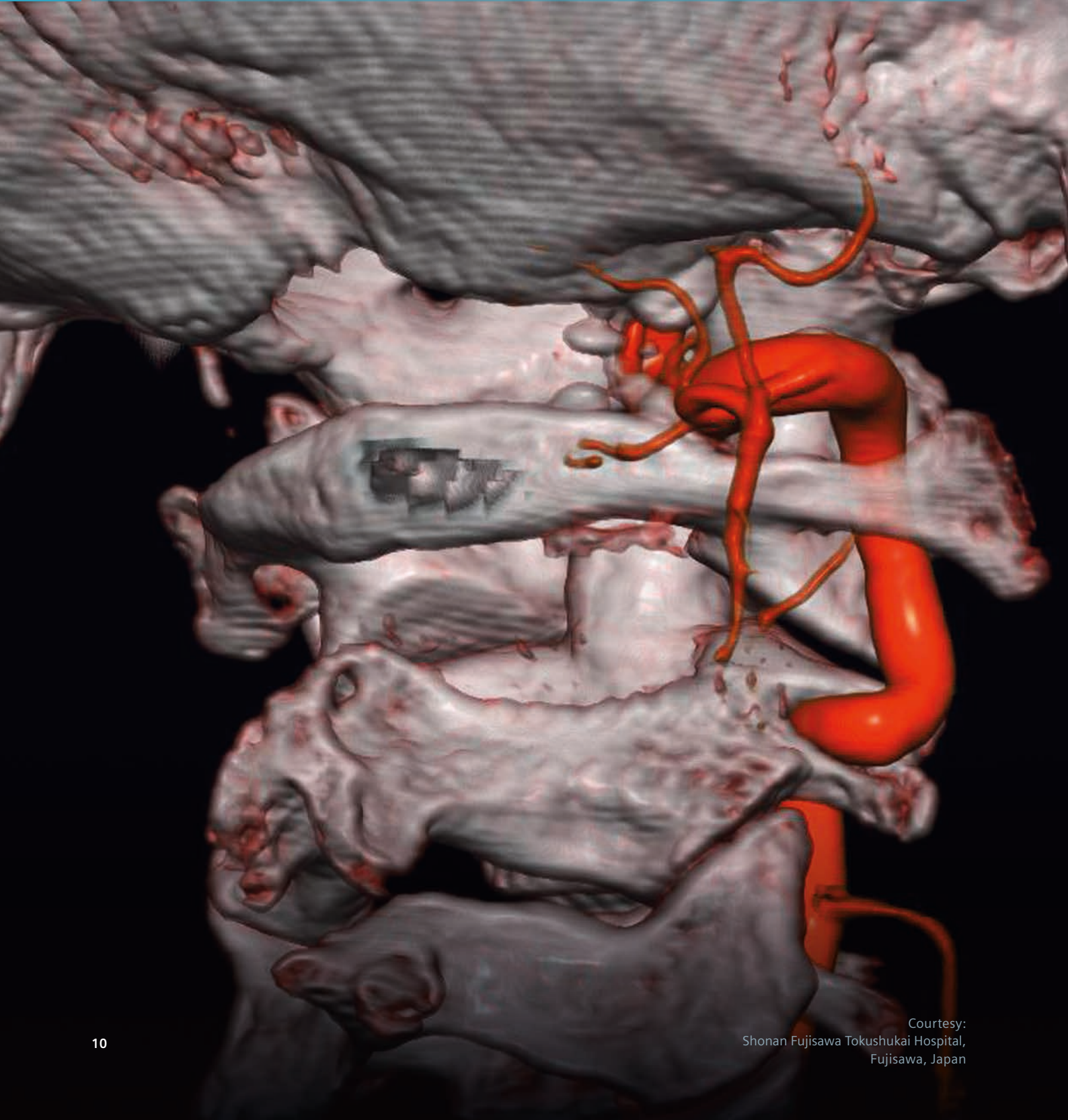
Highest precision is difficult to accomplish in complex cases. With the right technology, you can achieve the best outcomes.

## At a glance:

- High image quality and large 3D Field of View showing up to 7 vertebrae – even 10 with Large Volume *syngo* DynaCT
- Strong power generator (up to 100 kW) for optimal image quality even in obese patients or lateral views at low dose
- Image fusion for all necessary information in one image
- Best available hard contrast resolution and metal artifact reduction for uncompromised image assessment
- Automatic image registration and transfer for navigation systems
- High-precision image-guided screw placement

<sup>3</sup> See, for example: Soroceanu A, Burton DC, Diebo BG, Smith JS, et al. Impact of obesity on complications, infection, and patient-reported outcomes in adult spinal deformity surgery. *J Neurosurg Spine*. 2015 Jul 31: 1–9. [Epub ahead of print] and Wang J, Zhou Y, Feng Zhang Z, Qing Li C, et al. Comparison of the clinical outcome in overweight or obese patients after minimally invasive versus open transforaminal lumbar interbody fusion. *J Spinal Disord Tech*. 2014 Jun; 27(4): 202–6. doi: 10.1097/BSD.0b013e31825d68ac.

# High-image quality

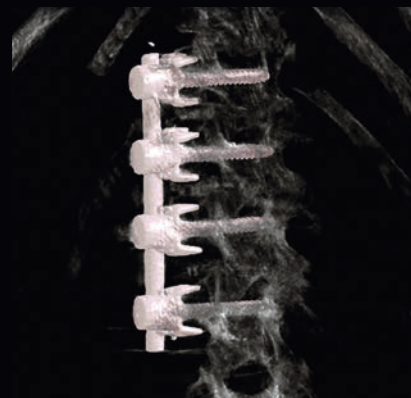
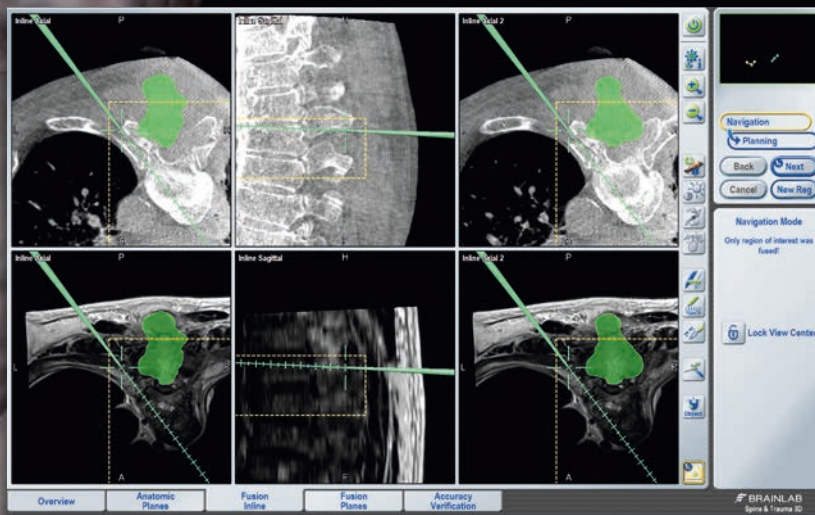




# High-resolution imaging in the hybrid OR



Artis zeego takes complex surgery to a new level – enabling complex and challenging cases that may not have been possible before.



**Optimal quality management** – supported by large Field of View and high-precision visualization of positioned screws

**All necessary information in one image** – image fusion of a pre-operative MR scan (soft tissue characterization) and intra-operative syngo DynaCT (hard contrast and anatomic information in combination with a Brainlab navigation system)

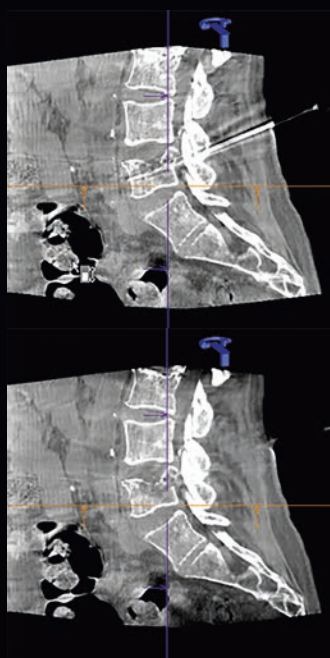
Courtesy:  
Ulm University Hospital,  
Germany

Courtesy:  
Cliniques Universitaires Saint-Luc  
Brussels, Belgium




**Excellent spatial resolution** – With osteoporotic patients, the visualization of small fragments can be challenging. For such cases, syngo DynaCT Micro offers spatial resolution of 0.1 mm.

Courtesy:  
Cliniques Universitaires Saint-Luc  
Brussels, Belgium



**Metal artifact reduction** – reduced metal artifacts facilitate overview and decision-making significantly

Courtesy:  
Magdeburg University Hospital,  
Germany

A portrait of Prof. Dr. Florian Gebhard, a middle-aged man with a mustache, wearing a white lab coat over a blue and white striped shirt. He is smiling and standing in a modern hospital corridor with glass walls and recessed ceiling lights. A blue identification badge is pinned to his lab coat.

*“Since we perform spinal surgery exclusively in the hybrid OR, not one single screw position has required revision.”*

Prof. Dr. Florian Gebhard, Medical Director

Trauma Surgery, Ulm University Hospital, Germany



## Fewer corrections and readmissions

A hybrid OR environment with the right imaging technology increases accuracy in spine surgery and can reduce secondary surgeries. However, the risk of incorrectly placed screws and complications should not be underestimated.



### The importance of reducing secondary surgeries

Due to incorrectly placed screws or other complications, spine patients are often rescheduled for the OR within the same hospital stay. Such reoperations put a strain on patients, surgeons, and institutions alike: for patients, they mean additional risk and potential worsening of their condition; for surgeons, the issue is satisfaction, confidence, and reputation; for institutions, they can lead to legal disputes or economic damage. The hybrid OR concept in spine surgery is therefore specifically designed to help increase patient safety as well as precision in screw placement.

### Maintaining a sterile environment

Spine procedures require the most sterile conditions. To secure such an environment, Artis zeego can easily be covered with sterile drapes – and, more importantly, it does not disturb the laminar airflow field, fulfilling the highest hygienic standards (class 1A). Infections and associated risks, like patient cooling, are reduced due to shortened OR times thanks to the workflow with Artis zeego.

### The big picture

Optimal visualization and overview during procedures is safeguarded both by Artis zeego's excellent image quality and a Field of View that makes it possible to acquire images of up to 10 vertebral bodies in 2D and even 3D. This way, surgeons can see a larger segment of the spine in one image – for confident decision making and quality control. Apart from 2D and 3D imaging, the image composition option lets the

surgeon combine single fluoroscopic images into one large overview. The entire spine can be visualized in just a few steps. Surgeons thus always know precisely where they are without having to sacrifice the general overview.

### Safety

Before closure, a final 3D run confirms the positions of all screws. Misplacements can be detected – and immediately adjusted – while the patient is still in the OR. No post-operative CT scan is necessary. The surgeon can finish confidently and send the patient back to the ward.

### Quality management

Confident quality assessment requires high-precision imaging at all times. This comprises exact planning, implementation, and checking at the end of surgery. A fixed C-arm such as Artis zeego delivers the high precision that is needed for optimal quality management in the hybrid OR – especially for difficult cases and challenging surgical techniques. Because improved quality care improves the confidence and satisfaction of all involved parties, it can help institutions gain a positive reputation and even reduce socioeconomic costs.

**No repetition:** Our solutions help reduce post-operative corrections significantly.

### At a glance:

- Maintaining highest hygienic standards for decreased infection risk
- Intra-operative quality control makes post-operative CT obsolete
- Large Field of View and image composition option for optimal visualization and better overview
- Excellent quality management for confident decision making and greater patient safety

<sup>4</sup> For increased accuracy of screw placement with 3D fluoroscopy, see: Tian NF, Huang QS, Zhou P, et al. Pedicle screw insertion accuracy with different assisted methods: a systematic review and meta-analysis of comparative studies. *Eur Spine J.* 2011 Jun;20(6):846–59. doi: 10.1007/s00586-010-1577-5. Epub 2010 Sep 23.

# Ultralow complication

## Reducing the number of secondary surgeries and complications

In minimally invasive spine surgery, the highest image quality and precision in screw placement are key to increasing patient safety.

0.18%

ULTRA-  
LOW

COMPLICATION RATE

*“We also reduced the complication rate: of 5,041 screws implanted, only nine screws had to be reinserted, which means an ultralow complication rate of only 0.18%.”*

Dr. Sohei Ebara, Director

Spine and Scoliosis Center, Shonan Fujisawa Tokushukai Hospital, Fujisawa, Japan





rate

**Superior outcome quality**

Since the introduction of Artis zeego in October 2012, Shonan Fujisawa Tokushukai Hospital in Japan has been able to reduce the number of complications significantly. For Dr. Sohei Ebara, vice president of the hospital and medical director of the spine and scoliosis center, the most important aspect is the superior outcome quality:

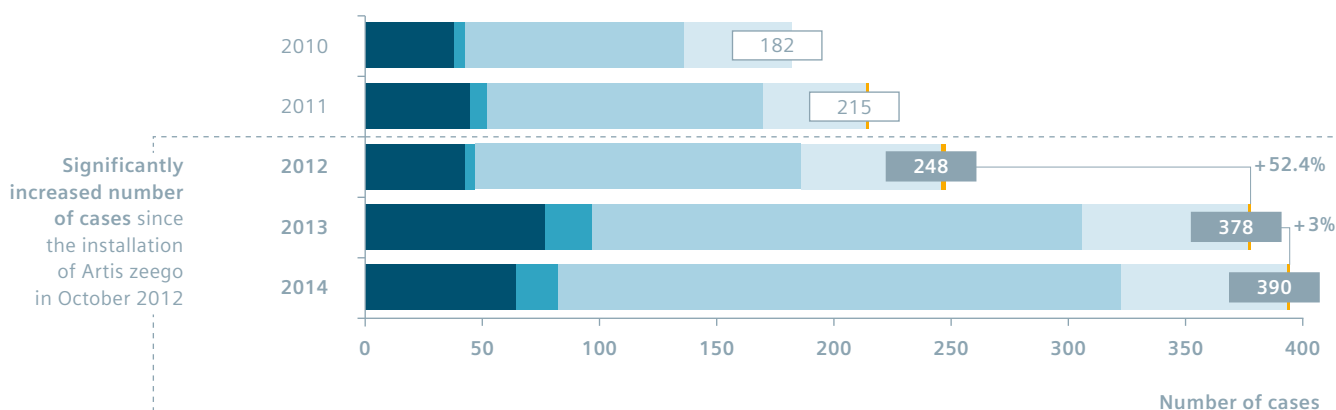
Using syngo DynaCT for precise control of screw placement, Dr. Ebara and his team were able to reduce the number of screws that had to be reinserted to an absolute minimum.

Courtesy:  
Shonan Fujisawa Tokushukai Hospital,  
Fujisawa, Japan



## And it is also good for your business

Reduced operating time, the ability to handle complex cases, and an ultralow complication rate can increase the number of cases and boost business, as the example of Dr. Ebara and his team at Shonan Fujisawa Tokushukai Hospital shows.



## Enabling technology for spine surgery

Profit from Artis zeego and dedicated software for state-of-the-art imaging in spine surgery.

### Artis zeego

Artis zeego is the first multi-axis system based on robotic technology that can be positioned the way you want. Artis zeego is constructed to overcome the limitations of conventional systems in the OR environment. It offers high-end applications for surgery through 3D imaging, high frame rates, and excellent image quality at low dose.



#### Ultrafast 3D imaging

*syngo* DynaCT enables you to acquire 3D images within seconds.

#### Large Field of View in 2D

A large 30 x 40 detector allows a Field of View with up to 10 vertebral bodies.

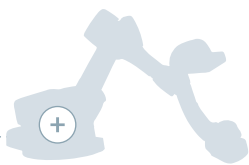
#### Extended Field of View in 3D

The combination of two *syngo* DynaCT images into one volume increases the Field of View to up to 10 vertebral bodies, including in 3D.

#### High-resolution imaging

A strong power generator with 100 kW provides high-resolution images even in





- C-spine
- T-spine
- L-spine
- Scoliosis
- Others

obese patients or difficult anatomy. The smallest details can be visualized with syngo DynaCT Micro for a hard contrast resolution as low as 0.1 mm using each detector pixel.

#### Metal artifact reduction

Important information can be obscured by metal artifacts. Reduce these artifacts – with syngo DynaCT SMART (Streak Metal Artifact Reduction Technique).

#### Fusion imaging

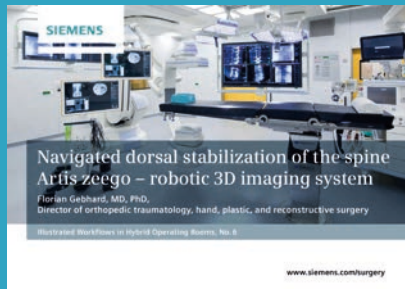
With the syngo Fusion Package, 2D/3D fusion and 3D/3D fusion of intra-operative and pre-operative imaging combines all the necessary information into one image.

## Find out more about spine-specific workflows



#### Illustrated workflows in Hybrid Operating Rooms, No.2

Cliniques Universitaires Saint-Luc in Brussels, Belgium



#### Illustrated workflows in Hybrid Operating Rooms, No. 6

University hospital of Ulm, Germany



#### Overview of spinal workflows in Hybrid Operating Rooms

Shonan Fujisawa Tokushukai Hospital, Spine and Scoliosis Center, Japan



#### Overview of a multidisciplinary approach in Hybrid Operating Rooms

Sahlgrenska University Hospital, Gothenburg, Sweden



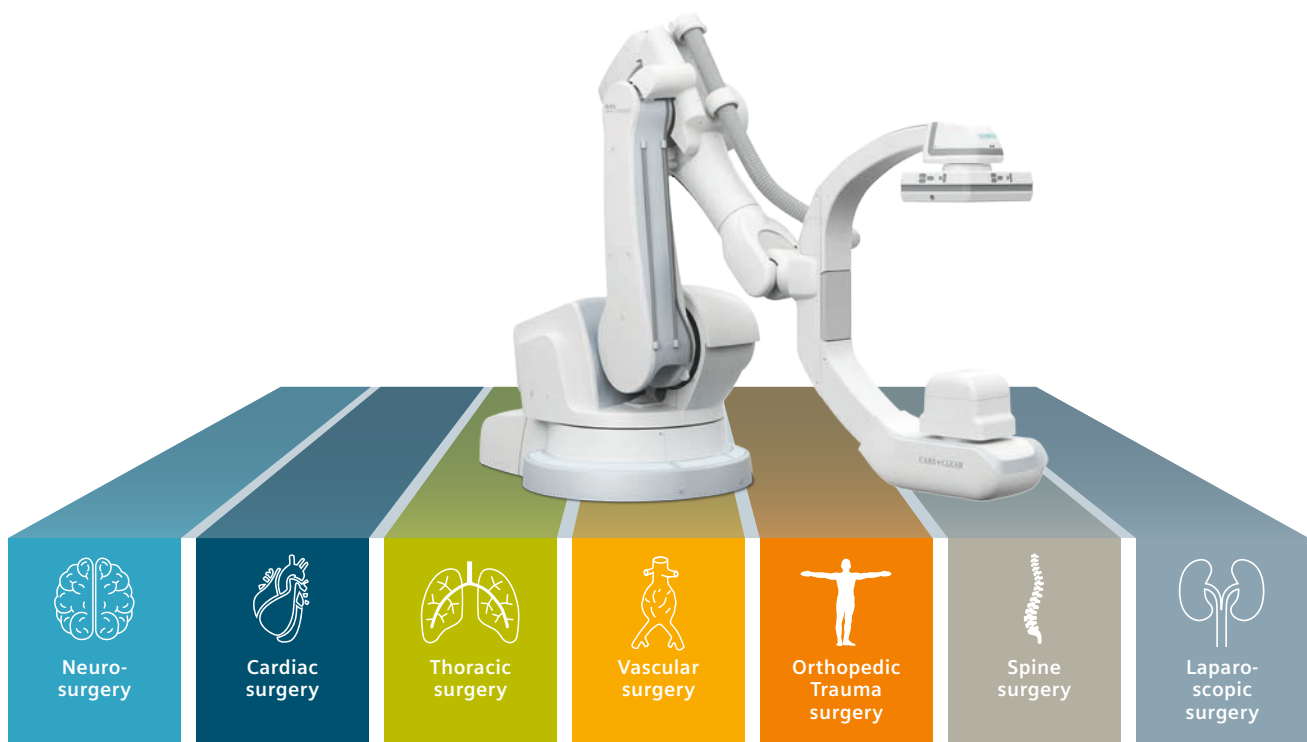
*“The installation of a hybrid OR will become a matter of necessity for major surgery centers. When it comes to economic feasibility, multispecialty usage appears to be an outstanding solution.”*

Prof. Dr. Florian Gebhard, MD

Trauma Surgery, Ulm University Hospital, Germany

## High utilization of the hybrid OR

A hybrid OR with a fixed imaging device is not only the perfect working environment for spine surgery, but also for specialists from other surgical disciplines.



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reader on your  
mobile phone!

### Accommodating many different needs

Dedicated spine centers with a high case load may operate a hybrid OR at full capacity. This may, however, not be the case everywhere. Other surgical disciplines can increase the utilization of the hybrid OR. Multidisciplinary use has evolved to be the gold standard for certain procedures in vascular and cardiac surgery, like EVAR (endovascular aortic repair) or TAVI (transcatheter aortic valve implantation). Spine surgeons, whether they are coming from neurosurgery or from orthopedic trauma surgery, may of course also use Artis zeego for other procedures in their respective realms. Neurosurgeons, for example, benefit from it in neurosurgery or in stereotactic and skull-based tumor surgery. Orthopedic trauma surgeons, on the other hand, can use the system for pelvic surgery, complex fracture treatment, and musculoskeletal tumor surgery. Another use case could be the triage of trauma patients and simultaneous multidisciplinary treatment.

Of course, this means that the hybrid OR must meet the different requirements in terms of patient positioning, patient access, and hygiene. If designed in a way that accommodates all needs and leaves enough room, various disciplines can work in the same environment. In times of increasing cost pressure, a multidisciplinary approach to a hybrid OR can thus lead to high utilization and justification of the investment.

### Planning a hybrid OR

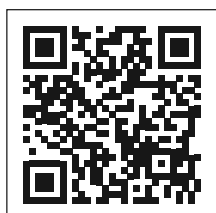
Ideally, all relevant parties are involved from the beginning in order to determine the optimal setup. As the fixed imaging system plays a central role in the hybrid OR, both the configuration of the room itself as well as the positioning of the imaging system are important. The requirements of each surgical discipline need to be met. Considerations such as room size, positioning of components such as OR lights, choosing the right table, and adding other technology like navigation systems or microscopes are crucial when developing the optimal workflow in the hybrid environment. We help you with expert guidance in the planning stage. Profit from a dedicated planning department with experience in hundreds of hybrid ORs.

### A solution that pays off

Quite often, it is the cooperation of various disciplines that makes the hybrid OR possible in the first place – because it safeguards utilization of the room, which in turn warrants the investment. A hybrid OR not only lets you perform combined and complex procedures previously not possible, it also supports optimized patient treatment leading to a higher standard of care. The concept of a hybrid OR supports you in making your institution future-proof with state-of-the-art treatment options. This can help you improve your reputation and attract patients, convince referrers, and recruit skilled personnel.

### Watch the interview:

Prof. Dr. Florian Gebhard's advice: Ask your colleagues to share the OR!  
Watch the full interview: [siemens.com/share-the-or](http://siemens.com/share-the-or)



Read the  
QR code with  
the QR code  
reader on your  
mobile phone!

### At a glance:

- Expand your treatment range and handle more complex procedures
- Improve quality of care
- Safeguard your investment and be ready for the future
- Enhance your reputation among patients, referrers, and potential employees



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