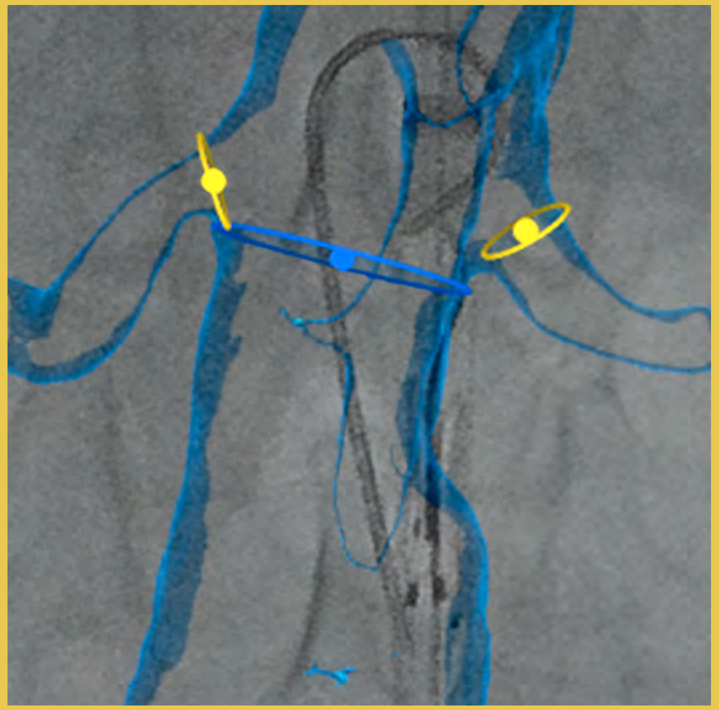
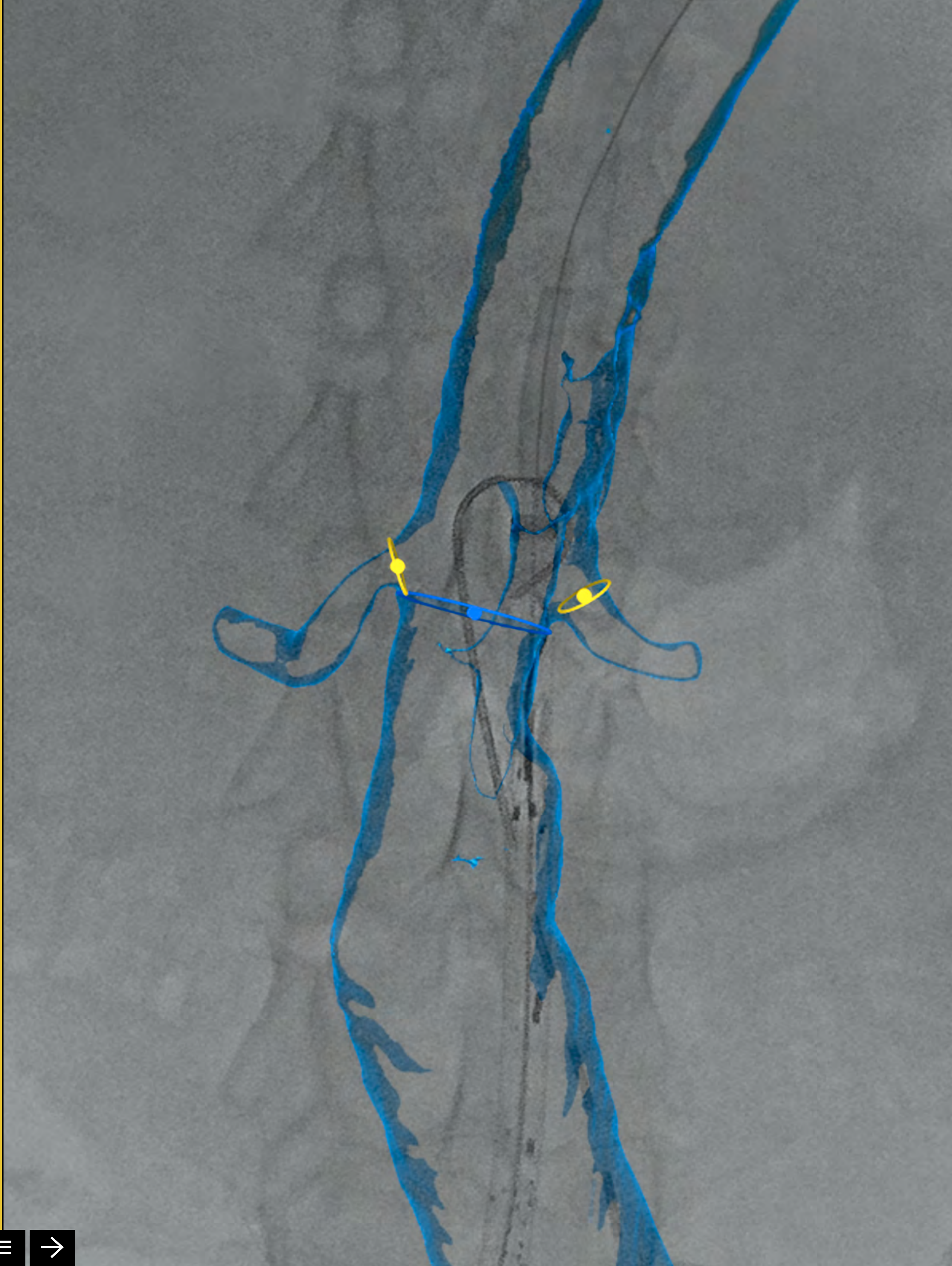
Content

IMAGING



#5
An annual publication presented by
ziehm imaging



Previous page
Image of the body trunk created with the Vascular Trunk program and combined with a fusion overlay of the abdominal aorta for intraoperative navigation of an endovascular aortic repair (EVAR). The image was acquired at University Hospital of Giessen and Marburg (UKGM) in Giessen, Germany, using a Ziehm Vision RFD Hybrid Edition CMOSline, and image fusion was performed using the Therenva EndoNaut 3D vascular navigation system.

50 years

From the very beginning, our focus in developing products has been on satisfying the needs of clinical users and patients. Since the company was founded in 1972, Ziehm Imaging has followed this principle and evolved over the years with many bright and passionate people: our employees, our partners, and our friends in the industry.

In this special anniversary issue, we are celebrating the past 50 years that have shaped who we are today and brought many innovative mobile imaging solutions to life. You'll get to know some of our team – those who drive this company every day with their ideas and dedication – and explore how an ingenious small box evolved into state-of-the-art imaging and dose-saving technology. In France, Prof. Dr. Adrien Kaladji lets you into the OR as he performs a cardiovascular intervention using image fusion with our mobile C-arm and the Therenva EndoNaut system. Then take a look at how mobile 3D imaging brings orthodontic surgery to the next level in Finland and learn how a mobile CathLab can be a real alternative to typical cardiac catheterization laboratories. Also, I am very pleased to have our long-standing partner Prof. Dr. Christoph Josten speak about our journey together and how it has added value to mobile imaging solutions over the years. Together with the University Hospital Munich, we focus on the further development of our systems for use in everyday clinical practice.

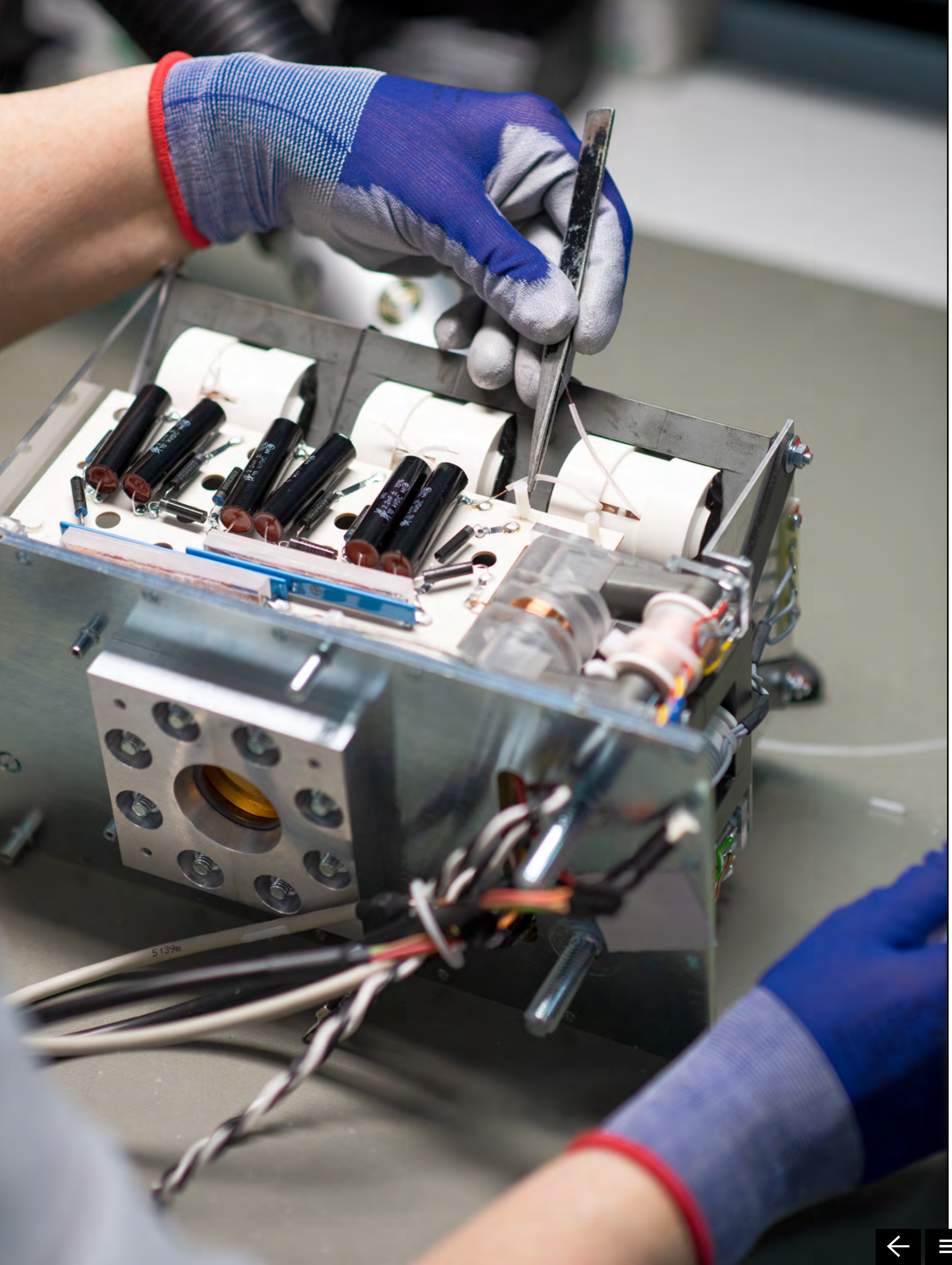
To 50 years of Ziehm Imaging: 50 years of making the invisible visible.

Martin Törnvik
Vice President Global Sales and Marketing

Photos
Juli Sing

Great people

For five decades, Ziehm Imaging's success has been based on the right people developing and implementing the right ideas at the right time. Meet some of the team members who are setting standards in the company in various positions today and bringing the brand into the future with their personalities and know-how. A team spirit that has grown over the years characterizes all of our projects across all areas.



Else Schwan remembers starting at Ziehm Imaging 15 years ago. Back then, she learned to assemble the first generator for the Ziehm 8000 system, and she still enjoys doing it today. She places the stationary anode precisely in the right place, soldering each cable with a sure touch and then testing the generator. Currently, she also assembles generators for the Ziehm Solo and Ziehm Vision. She puts the heart into the systems, as she warmly describes it.

Problem solver Riccardo Bellimbusto is one of the Service Hotline technicians. He repairs systems at the headquarters or at customers' sites, including in his native Italy. Riccardo enjoys the varied routine as a service technician, and customer satisfaction is extremely important to him. Another focus is continuing to develop Remote Service at Ziehm Imaging with other departments and partners, exploring the feasibility of remote system maintenance, and supporting clinics as quickly as possible in the event of problems.

Around 20 years ago, Christian Hurle returned to southern Germany from Silicon Valley and programmed the interface of the first flat-panel detector. The positive feedback from the field quickly gave him the feeling that he was on the right track in medical technology. Today, as Director Research and Development Hardware, he is responsible for system development. His focus has been on the innovation of image storage and the image chain to achieve the best possible image quality at the lowest possible dose.

Martin Törnvik is a networker who has been representing the Ziehm Imaging brand for over 30 years. After his engineering studies in electronics, he was based in Sweden, distributed C-arms in the Northern European region and established valuable contacts. His knowledge of the market, sales, and products led him to the company headquarters in the early 2000s. Among other things, he helped shape the launch of Ziehm Vision and the evolution of this system into Ziehm Vision FD, starting the paradigm shift towards flat-panel detectors in the product portfolio.

Product Manager Franziska Abele has been looking after Ziehm Imaging's high-end systems, such as the Ziehm Vision RFD Hybrid Edition[1], for almost four years. Through her constant contact with doctors and visits to operating rooms, the medical technologist is familiar with what practices need and identifies the best technical solutions with her colleagues and partners. Her current focus is on driving cardiovascular imaging forward, in close cooperation with the subsidiary Therenva.

Danijela Vrankovic's day-to-day work is all about the people who work at Ziehm Imaging. The specialist for employer branding appreciates the daily interpersonal exchanges and is committed to creating a vibrant corporate culture. She evaluates the needs of employees at Ziehm Imaging and presents the exciting fields of activity within the company to the world.

Great moments

In 1972, a technical revolution resulted in the foundation of Ziehm GmbH. Today, after five decades of further innovation in medical technology, the company leads the world in the field of intraoperative medical X-ray imaging.

In the early 1970s, Jürgen Ziehm's idea for controlling X-ray imaging equipment through an automatic exposure machine became reality. The engineer built a box that was slightly larger than two shoeboxes. It was called Expomat (→ p. 20, 1) and it fundamentally changed the medical imaging market. Without previous technical developments in medicine, this discovery would not have been possible. The origins of this medical technology go back to the 19th century. The discovery of X-rays by Wilhelm Conrad Röntgen on November 8, 1895, proved to be groundbreaking. Just one year later, the X-ray process was already being used worldwide, and as the 20th century began, X-ray equipment became an established part of medical practice.

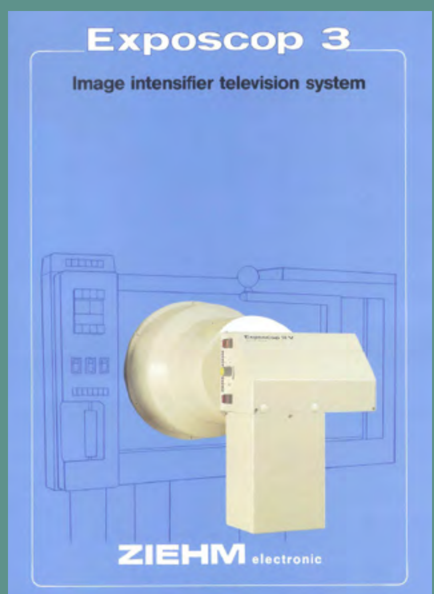
Back then, little was known about X-rays. Over time, scientists recognized the connection between radiation damage and X-ray technology and developed the first instruments for measuring the amount of radiation absorbed by the body.

Intraoperative imaging as we know it today developed after the Second World War: The representation of bones continued to improve, and modern angiography got its start with the first percutaneous vascular puncture in 1953, which was followed a few years later by the first coronary angiogram. Two other events created the basis of angiography as we know it today: the introduction of Gastrografin, a contrast agent that is well-tolerated, at the end of the 1950s and percutaneous angioplasty, or the opening of an closed artery with the aid of a catheter, in the late 1960s. The first C-arm, introduced by Hugo Rost in 1954, enabled surgical teams to move the imaging device to patients and not vice versa, as had been the case up until then. This system offers clear advantages during surgical procedures.

Despite these groundbreaking developments, at the beginning of the 1970s medical staff were still estimating the required X-ray dose. This often resulted in incorrect exposures. Images had to be taken repeatedly, and patients and the medical staff underwent multiple exposures to radiation. This is where Jürgen Ziehm's idea came into play. He developed an automatic exposure technique that directly resulted in a correctly exposed image. This solution for everyday clinical use not only enabled a more precise dose of X-rays, but also prevented exposure errors, thus minimizing radiation exposure for patients and equipment users. The Expomat resulted in the establishment of Ziehm GmbH in 1972. In the following years, it was manufactured at the production site on Löffelholzstrasse in Nuremberg. In parallel with production, Jürgen Ziehm continued to develop his product because radiation protection was becoming a central issue in medical X-ray technology.

Expomat, Exposcop and progress in imaging techniques

In 1973, the X-ray Ordinance (RöV) took effect in Germany. From then on, solutions for dose measurement and regulation were more in demand than ever.



1 Expomat, 1972, innovative automatic exposure technology that directly resulted in a correctly exposed image, developed by Jürgen Ziehm.
2 Exposcop, approx. 1978, a subsequent model of the first complete image intensifier system, including automatic dose rate control. The Exposcop family of subsequent products based on the Exposcop sold successfully into the 1980s.
3 EXPOSCOP CB7-D, 1984, the first C-arm with digital image storage and a high-frequency generator, the monoblock generator.

Just one year after the X-ray Ordinance was introduced and magnetic resonance imaging was developed, Ziehm GmbH brought the Exposcop (→ p. 20,2) onto the market. The first complete image intensifier system with automatic dose rate control was available in two types: RZ 2008 and RZ 2006. The Exposcop used fluoroscopy technology to make moving processes visible as well. Later, the Exposcop product family was developed and several thousand of these products were delivered worldwide during the 1980s.

Ziehm sets new standards for the C-arm

In 1982, the company was renamed Raytronic Ziehm GmbH. Based on years of experience and expertise in the field of imaging, the first Ziehm C-arm was developed and introduced to professionals in 1983. This device was more compact and mobile than previous equipment and it allowed the patient to receive a lower dose of radiation without compromising image quality. Ziehm was the first supplier to house the complete generator and the X-ray tubes in a housing directly on the C-arm across from the image, the so-called monoblock generator. Since then, the company's consistent focus has been the further development of mobile C-arms, emphasizing user-friendliness and patient protection.

Following the introduction of digital computer tomography, the 1980s saw the rise of digital subtraction angiography (DSA), the first computer-assisted two-dimensional X-ray technology. In 1985, Raytronic Ziehm GmbH launched the Exposcop CB7-D (→ p. 20,3), the first C-arm with digital image memory and digital image processing. It was quickly apparent how well this development accommodated the changes in the healthcare sector. The simultaneous introduction of IT in medicine resulted in the increasing automation of individual processes. For example, the digital recording and archiving of patient data began and healthcare providers became increasingly open to digital solutions. The Exposcop CB7-D system not only proved successful in Germany, Austria, and Switzerland, but it was also exported to the USA and to the African and Australian markets.

The company sold about 230 C-arms annually and employed 80 people. Due to increasing customer demand, eventually the production facility at Löffelholzstrasse was no longer large enough, so the company moved to the site at Isarstrasse 40 near the Nuremberg harbor in 1987. There, in close cooperation with vascular surgeon Dr. Lutz Helmig and with Günter Stelzer, head of medical documentation, statistics and medical technology at the Oberwald Clinic in Grebenhain, the company developed the first DSA-capable C-arm based on the Exposcop CB7-D. Digital subtraction angiography (DSA) is a diagnostic procedure for imaging blood vessels (angiography) and it provides even more accurate results than the conventional imaging of blood vessels. The Exposcop Type CB 745 C-arm with DSA functionality was the first of its kind in the world when it was launched in 1988. The company, which was now called Ziehm GmbH again, maintained this unique selling point for C-arms for many years, thus consolidating its position in the market.

Digital performance and more flexibility for small spaces

Space has always been important in operating rooms: Various devices and the surgical team need room so that procedures can be completed quickly and safely. With this in mind, in 1994 Ziehm introduced the Exposcop Type CB 745, the first compact unit on the market that could be used without a monitor cart. This model was further developed into the Exposcop CB 752 series, with optimized design elements that are still present in some of today's models. Further developments of the compact unit also took digitization into account and featured a CCD camera and sophisticated image storage and post-processing as well as extensive documentation options (Exposcop CB 7000), digital image management, and advanced anatomical programmed radiography (Exposcop CB 8000).

The Finnish group Instrumentarium Imaging took over Ziehm GmbH in January 2000. The export business boomed, and the number of units produced per year skyrocketed. The company successfully established its innovations and products internationally – and integrated global trends into their development: The Ziehm Vista (→ p. 20,5), designed for specific requirements in the fields of orthopedics, vascular surgery, and endoscopy, came onto the market in 2001, and the Ziehm Vision system (→ p. 20,4) with the first software-based user interface with a touchscreen was also introduced and launched in the European market in 2003. Even before the advent of Web 2.0, when global networking entered new dimensions, Ziehm presented the Ziehm Vision Flat (→ p. 20,6), the first fully digital C-arm concept. It was later brought onto the market under the name Ziehm Vision FD.

New corporate structure and international expansion

Starting in 2003, Instrumentarium Imaging Ziehm GmbH began focusing on 3D X-ray imaging and introduced the Vision Vario 3D system in March. Just a few years later, the company had developed the 3D C-arm with its technology to market maturity. Motivated by the global activities and connections of the Finnish parent company, Instrumentarium Imaging Ziehm GmbH entered the Asian market and founded Ziehm Inc. to increase its presence in the US market. In 2004, Instrumentarium Imaging Ziehm GmbH in Nuremberg and Ziehm Inc. in Riverside merged to form Ziehm Imaging, a new, independent company. This company was taken over by ATON GmbH in the same year. The owner of the holding company was and still is the vascular surgeon and entrepreneur Dr. Lutz Helmig. Helmig was instrumental in the development of the first C-arm with DSA functionality in 1987. Starting in 2004, Ziehm Imaging had an international presence and established sites in Finland, Singapore, and Italy.

Advanced dose management for lower radiation exposure

Dose reduction in medical technology has always been a central topic in product development at Ziehm Imaging. This led to the development of the ODDC (Object Detected Dose Control) dose management system in 2005. It detects objects based on shape, position, and movement and controls the automatic dose regulation and noise filter accordingly. This reduces the radiation dose for equipment users and patients in everyday hospital use.

Flat-panel detectors and further improvements in image quality

Ziehm Imaging GmbH had grown to the point that the company needed to move to a larger building nearby located at Donaustrasse 31. Fundamental technical changes were also imminent. In 2006, Ziehm Imaging introduced the first mobile C-arm with a flat-panel detector. In addition to the common image intensifier, the narrow 20 cm × 20 cm flat-panel detector was added to the product portfolio, and the Ziehm Vision FD system conquered the market with this technology. The opening of the C-arm was now larger and offered physicians more space near the patient. The modern and more intelligent imaging design allowed distortion-free images with improved contrast and image quality to be produced at a lower dose of radiation.

That same year, the rotating anode was introduced and used in addition to the previous stationary anode. This enabled greater generator capacities and improved images. And 2006 started the market launch of the Ziehm Vision R system in the USA and Europe. The Ziehm Vision Vario C-arm followed in 2007, including a version with an image intensifier and, under the name Ziehm Vision FD Vario, with innovative flat-panel detector technology. The product portfolio was diverse and the company now had approximately 200 employees to support the sale of over 700 systems per year. The company opened additional production facilities on Donaustrasse.

On the road to worldwide success with 3D innovations

The company and its product family continued to grow. With an eye toward advancing mobile imaging, Ziehm Imaging consistently continued its development of the 3D process. The Ziehm Vision Vario 3D offered 3D imaging in a mobile C-arm. Subsequently, the company launched the Ziehm Vision FD Vario 3D, the first 3D C-arm with flat-panel detector technology. Previously, a classic C-arm could be used to generate 2D intraoperative X-ray images in near real time conditions. The mobile device by Ziehm Imaging now offered orthopedists an intraoperative 3D view of the surgical area as well. Today, this method is an integral part of many standardized procedures, especially in spine surgery. A sister company, Ziehm Medical (Shanghai) Co. Ltd., was established in China in 2008 in order to build up the Asian market presence. Today it is a fully owned subsidiary of Ziehm Imaging GmbH.

Even greater performance with a compact design

Because equipment users recognized and appreciated the advantages of flat-panel detectors, the Ziehm Vision R also underwent further development and was combined with flat-panel technology. In 2009, this work culminated in the Ziehm Vision RFD, which unites the powerful generating capacity of rotating anodes with the advantages of flat-panel detector technology. The compact Ziehm Solo model was launched at the same time. This device soon gained significance as it marked beginning of the cooperation between Ziehm Imaging and the German Armed Forces. Equipping field hospitals with the mobile X-ray units they needed was quite difficult because the narrow wheels were unsuitable for use with local ground conditions. Ziehm Imaging solved the problem with the Solo Portable model (→ p. 20,7). This compact unit with extra-wide wheels can be taken apart into individual components and delivered in a space-saving transport box. It can be assembled and ready for use quickly on site.

When the US company Orthoscan[2] was acquired in 2011, the product portfolio was expanded to include the mini C-arms (→ p. 20,8) used in limb surgery. The company, now a Ziehm subsidiary, is a leader in this area. Shortly afterward, to continue to expand the European market, Ziehm Imaging S.A.R.L. was founded in France.

4 Ziehm Vision, 2001, with the first software-based user interface with a touchscreen.
5 Ziehm Vista monitor cart, approx. 2001, designed to meet specific requirements in the fields of orthopedics, vascular surgery, and endoscopy.
6 Ziehm Vision Flat, 2001, first fully digital C-arm concept with a flat-panel detector.

7 Ziehm Solo Portable, 2010, a C-arm developed by Ziehm Imaging for the German Armed Forces, can be taken apart and reassembled on site for crisis operations, rescue missions, or in war zones to help meet the requirements for performing operations even in the most difficult conditions.

8 Orthoscan Tau 2020, mini C-arm with a 20 cm × 20 cm flat-panel detector with CMOS technology, a high-resolution, 27-inch LCD monitor, pulsed fluoroscopy, and other features that reduce dosage. Particularly suitable for pediatric applications.

9 Ziehm Vision RFD Hybrid Edition Cardio CMOSline, 2021, enables hybrid room procedures for demanding cardio and vascular surgery with a powerful, pulsed, 30 kW monoblock generator, CMOS flat-panel detector technology, and groundbreaking functionality that reduces dosage.

Practical solution for the hybrid OR

The amount of coronary disease continues to increase. Conventional operating rooms with built-in equipment are associated with complex planning and high costs. For this reason, hospitals need hybrid rooms with imaging equipment for minimally invasive procedures. In 2013, Ziehm provided a portable alternative solution in this area: The Ziehm Vision RFD Hybrid Edition, the first mobile C-arm with four-axis motorization as well as a rotating anode and 25 kW of generator power was brought onto the market for demanding hybrid surgeries. Unlike previous C-arms, the system can be easily operated with a motor. Any operating room can be easily and quickly used as a hybrid OR without extra construction or high investment costs.

In 2015, the company introduced the Ziehm Vision RFD 3D system, the first flat-panel 3D system to provide 180-degree image information, to the European market. This system created new options for everyday clinical practice. The combination of 2D and 3D functions in the system supports physicians with improved intraoperative control, which reduces the need for postoperative CT scans and revisions. The system is still sold successfully around the world.

In 2016, the compact Ziehm Solo with flat-panel detector technology was launched as the Ziehm Solo FD. In the same year, Ziehm Imaging introduced a process to mobile imaging that had been primarily used in photography up to this time: CMOS technology. In comparison with conventional a-Si technology, CMOS further reduced the radiation dose while providing very high image resolution. In the following year, this pioneering technology was incorporated into the first premium product family.

Everything under one roof: new company headquarters in southeast Nuremberg

Ziehm Imaging broke new ground in areas other than technology. Since 2017, Ziehm Imaging had full distribution rights for Orthoscan mini C-arms in Europe, the Middle East and Africa. In that year, the company also set up another subsidiary in Japan, another in Austria in 2018, and another in Spain in 2019 to further strengthen the brand in these countries. This was followed by the relocation of the headquarters to the Eurocom Business Park in southeast Nuremberg in 2020.

In 2019, the American subsidiary Orthoscan introduced the new flagship of mini C-arms, the Orthoscan TAU 2020. With features that reduce dosage, this device is particularly suitable for pediatric applications.

Software is also becoming increasingly important. To further expand this area and to find innovative solutions, in July 2020 Ziehm Imaging announced the acquisition of French software developer Therenva. Ziehm had already been collaborating with this company for many years in the field of mobile image fusion.

The use of mobile imaging technologies has also changed. Initially, only bones could be represented accurately with images and the applications were primarily in orthopedics and traumatology. Today, mobile C-arms are also essential in the cardiovascular field.

In this context, in 2021 Ziehm Imaging introduced the Ziehm Vision RFD Hybrid Edition Cardio (→ p. 20, 9) with the most powerful generator on the C-arm market. Equipment users in operating rooms experience even fewer motion artifacts, sharper details, and new cardio functions for coronary interventions and electrophysiology.

Outlook: precise imaging achieves success in more application areas

Cardiovascular imaging is becoming increasingly important as the amount of cardiovascular disease continues to rise. Mobile cardiac catheterization laboratories offer a significant contribution to the efficient use of available space in hospitals. The Ziehm Imaging system can be connected to hemodynamic measuring stations, and to special monitors and can transform a space into a mobile CathLab as necessary.

On the 50th anniversary of Ziehm Imaging, it is clear that the company has had a great deal of influence, but that it also has itself been shaped by many factors – by the medical technology industry, medical equipment users, patients, partners and employees.

Photos
Quentin Bassetti

> Clinical case movie

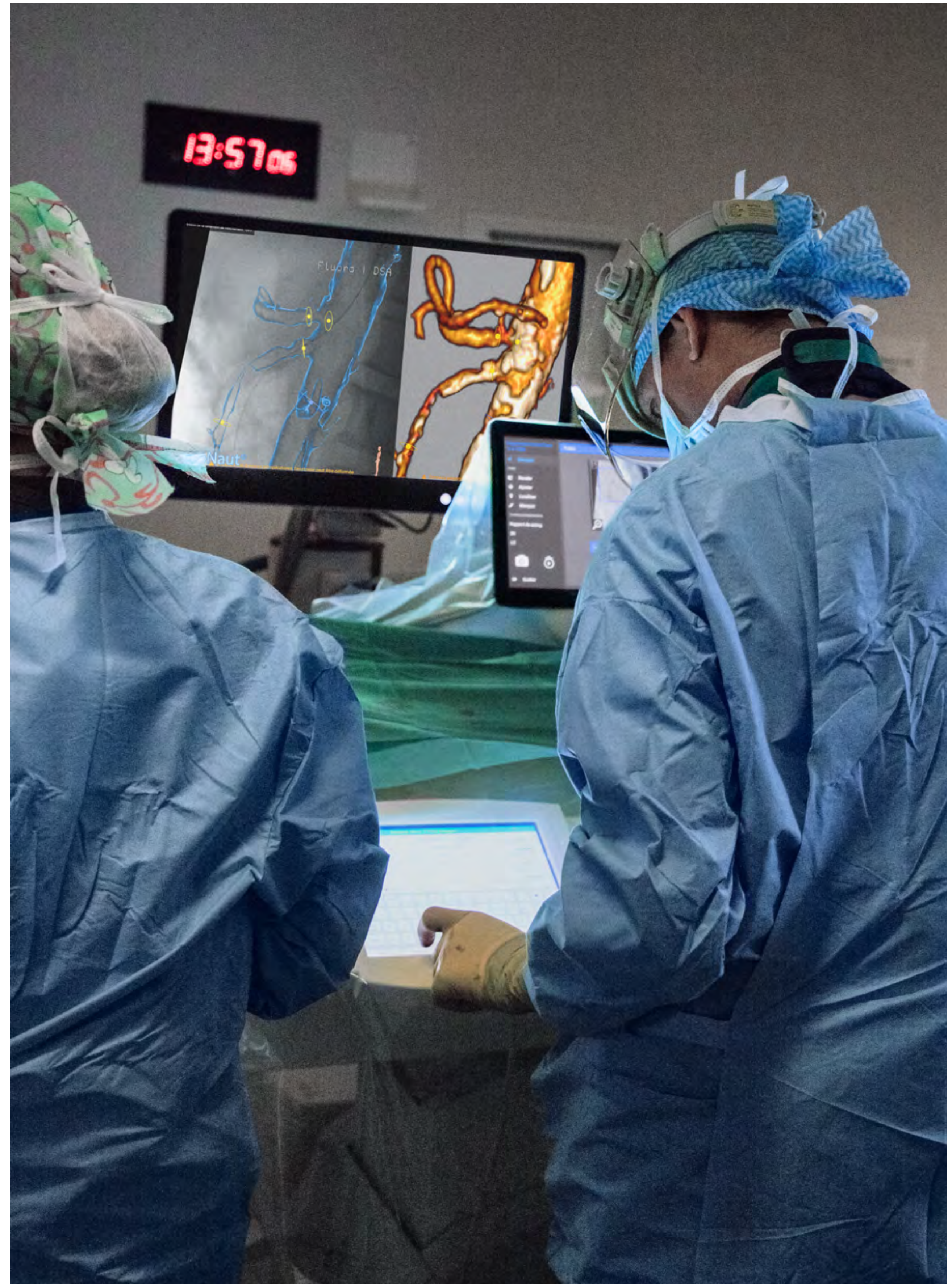
Fusion

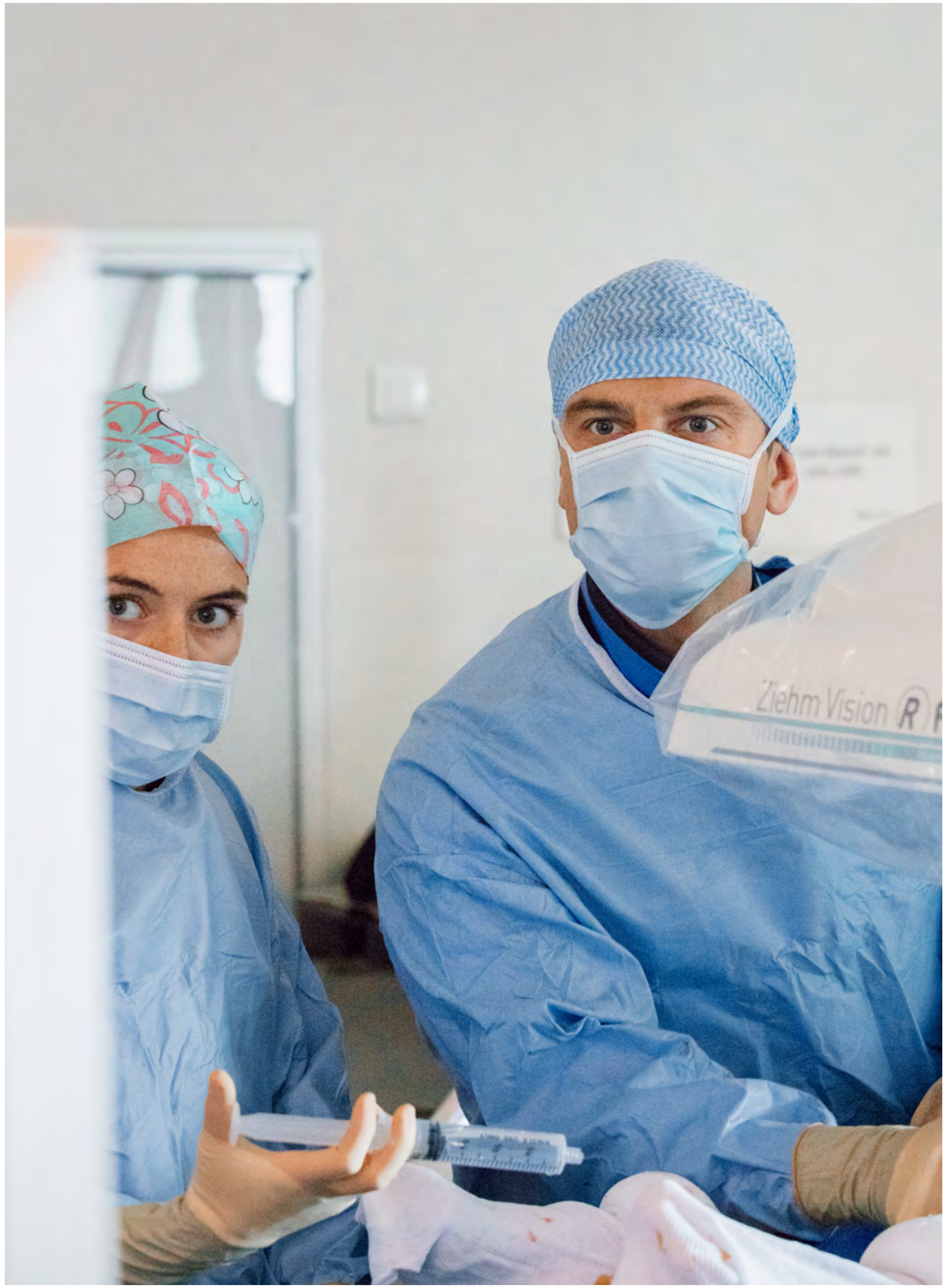
With the French subsidiary Therenva, Ziehm Imaging is shaping the future of mobile image fusion. Headquartered in Rennes, Therenva is a leading developer of 3D planning software for cardiovascular interventions. In his daily routine, Prof. Dr. Adrien Kaladji uses the combination of mobile C-arms and hardware as well as software packages for case planning and intraoperative navigation.

The EndoNaut automatically overlays the pre-processed CT images with the live C-arm images through a registration process based on the osseous structures.

Right side
At the remote vision center, Prof. Dr. Kaladji sets the parameters for the live image.

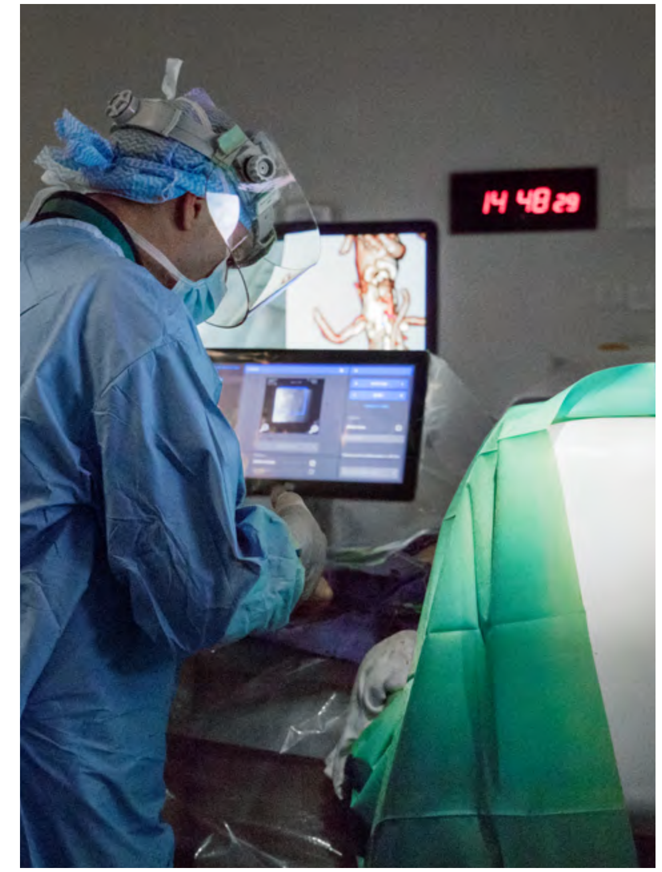
Brittany is a region in the northwest of France. It's capital, Rennes, is about 300 kilometers from Paris as the crow flies and is also known outside of France as a university city. In addition to culture, science, education, and research play a major role in Rennes. Prof. Dr. Adrien Kaladji, professor of Vascular Surgery at the University Hospital in Rennes, also studied and wrote his doctoral thesis at the University of Rennes. While there, he met Cemil Göksu, founder and CEO of the French company Therenva, in the research lab. "When Therenva was founded, Cemil and I were practically in the same room, so it was always possible to discuss his innovations. One day he asked me if I wanted to try out a software and I said 'ok.' Then I tested the EndoSize software, and I really liked it." The unique 3D planning software EndoSize supports Prof. Dr. Kaladji in his routine to this day. It enables the digital planning of minimally invasive vascular surgeries on a desktop computer or laptop. The plans are then stored in the hospital's imaging and communication system or on a USB stick for later use in the OR. In addition to determining the appropriate stents and C-arm angles for relevant imaging during surgery, the CT image acquired for diagnostic purposes can also be processed by the software. For example, the areas that need repair in the vessels, such as aneurysms, stenoses, and blockages can be marked. Adjacent vessel outlets can also be registered so that they are not blocked with stents during surgery. These markings support the surgeon during the operation because the processed image, including the markings, can be superimposed on the live image taken by the C-arm with the aid of the EndoNaut





By administering contrast agent,the team can see how the arteries expand and where irregularities occur.

After about an hour, an image is taken to check the position of the stents.



of the mobile Therenva system. It shows the physician where in the vessel the intervention is to take place. According to Prof. Dr. Kaladji, this procedure has advantages above all for the patient: “You have planned the intervention in advance. This helps especially with FEVAR and EVAR interventions. Without this option, we had to use more contrast agent and needed more images, which also led to a higher dose. At that time, for example, we didn’t know which perspective would produce the best view of the problem area. We had to improvise a lot more.”

Today, Prof. Dr. Kaladji heads the Department of Thoracic, Cardiac and Vascular Surgery at the Center for Cardiology and Pneumology at the University Hospital in Rennes with his colleagues. More than 2,000 vascular surgeries are performed there each year. Prof. Dr. Kaladji is an internationally-recognized expert in his field. The vascular surgeon operates as precisely and carefully as possible during each operation. And intraoperative imaging helps him. For this, he uses the Ziehm Vision RFD Hybrid Edition CMOSline[3] – its images impressed him from the beginning. Prof. Dr. Kaladji sees the significantly lower investment costs compared to a fixed system, and in the ease of operation as additional meaningful advantages of the mobile C-arm. The system just needs to be connected to the power supply in the OR and is immediately ready to use. In addition, its mobility allows the OR setup to be changed during the procedure, if necessary, thereby enabling more flexibility in the OR workflow than a permanently installed system. He uses the C-arm with Therenva’s EndoSize and EndoNaut systems. This enables the transferal of the

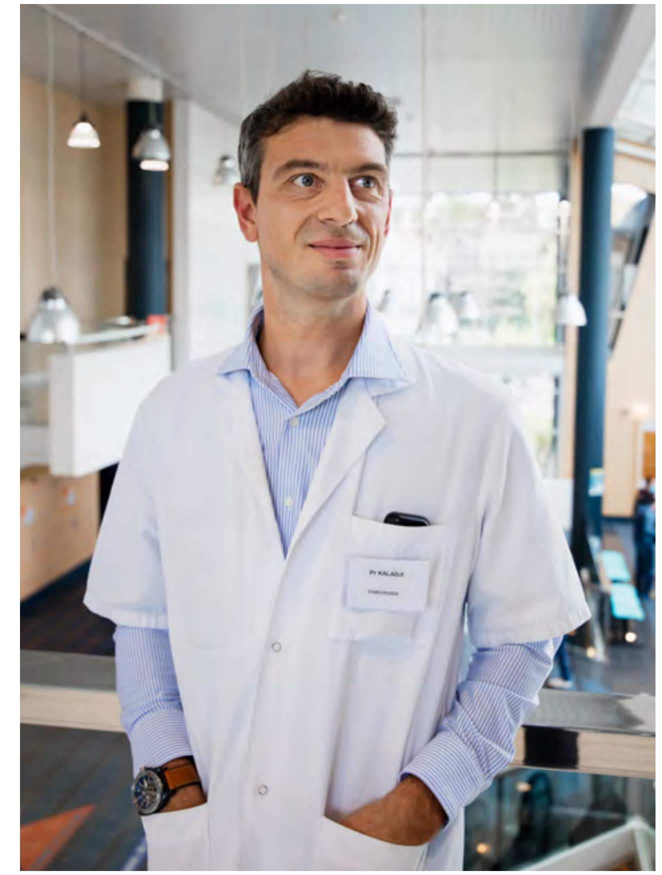
The combination of the Ziehm Vision RFD Hybrid Edition CMOSline mobile C-arm with Therenva's EndoSize and EndoNaut systems enables the connection of live images from the 2D world with 3D images. During surgery, each step can be precisely analyzed and corrected, if necessary, to avoid a follow-up intervention.

pre-planned surgical data to the live image acquired with the C-arm. In addition, real-time visualization of the instruments can be overlaid on the current patient images. The decisive factor is always the image quality of the fluoroscopic images of the C-arm. The sharper the images and the more clearly the contours are displayed, the better the results delivered by the image fusion of the C-arm 2D images with the EndoSize 3D images.

Today, Prof. Dr. Kaladji and his team are scheduled to revascularize a side branch of an aorta. The opening of such vascular occlusions is one of the standard procedures that Prof. Kaladji has been performing at the University Hospital in Rennes for more than ten years. After entering the operating room, the first thing Prof. Dr. Kaladji does is connect his USB stick to the EndoNaut. This is how he accesses and displays the EndoSize planning data on the screens of the Therenva system. In the next step, he uses the Ziehm Vision RFD Hybrid Edition CMOSline to see the locations of the vessel occlusions that he already saw on the CT image. He then starts the registration process, in which the CT image automatically adapts to the section of the live image. As soon as Prof. Dr. Kaladji confirms the image fusion on the EndoNaut touch panel, a blue vessel overlay including the points marked in EndoSize is displayed on the live image. To ensure that the vessel overlay is displayed in the correct location, Prof. Dr. Kaladji performs a control angiography with a small amount of contrast agent using the C-arm. Once he is satisfied with the position of the overlay, he can place the stents at the marked locations. He uses the Ziehm Vision RFD Hybrid Edition

More than 2,000 vascular surgeries are performed annually at the University Hospital in Rennes.

Together with his colleagues, Prof. Dr. Kaladji heads the Department of Thoracic, Cardiac and Vascular Surgery in the Center for Cardiology and Pneumology. His goal for every procedure is to be as careful as possible with the patient.



CMOSline to monitor progress. Once the stents are placed, Prof. Dr. Kaladji checks the result at the end of the procedure with the C-arm.

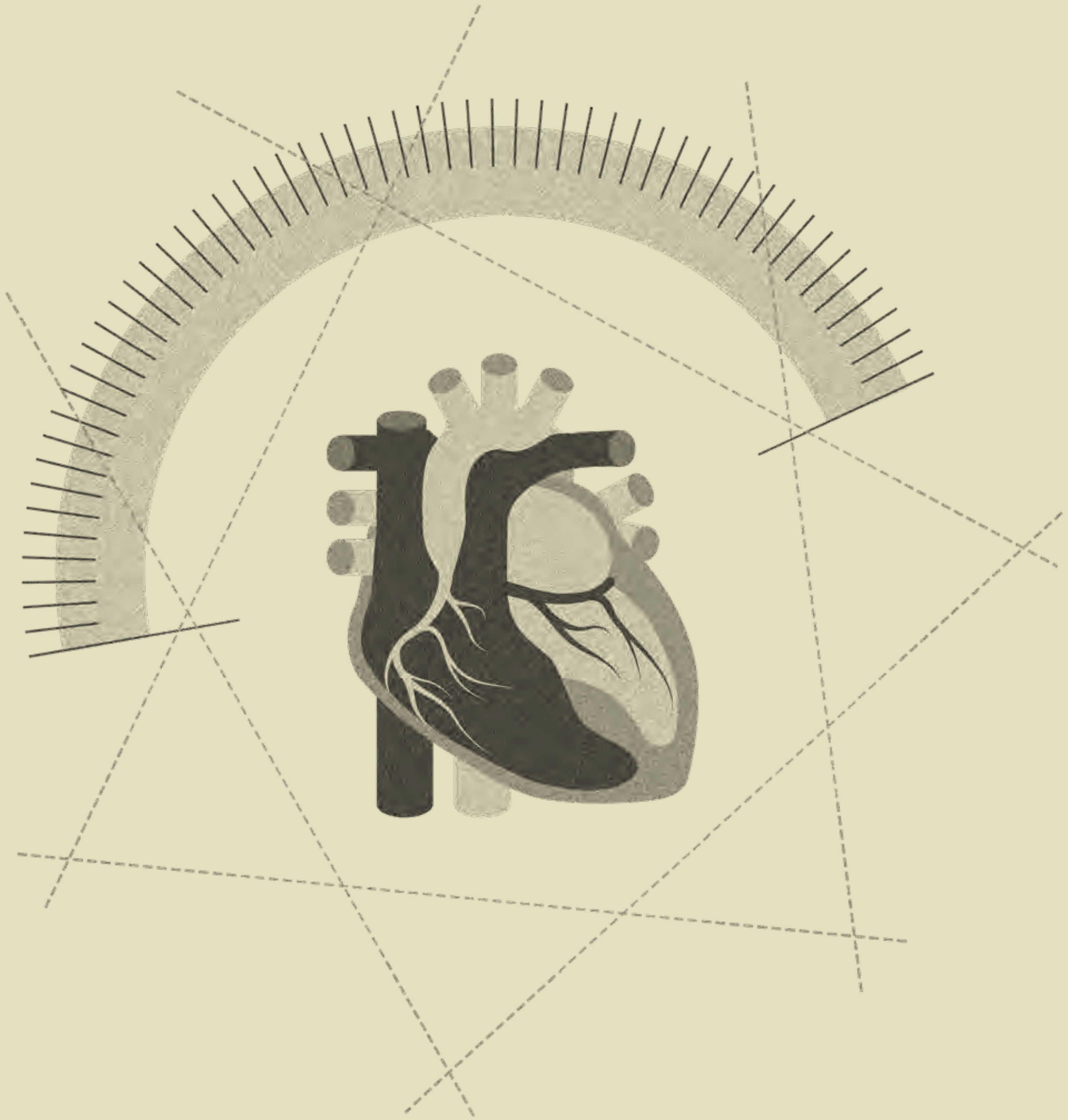
The combination of pre-planned surgical data and its fusion with live images during surgery is a tremendous advance in medical imaging for the vascular surgeon. “Before the combination of Ziehm Imaging and Therenva systems, we were well-acquainted with the really good imaging and intuitive handling of Ziehm’s mobile C-arm for surgeons. Now we are reaping the benefits of being able to combine world-class 2D imaging with a 3D imaging environment. We have used many different C-arms, but Ziehm Imaging’s mobile C-arm was the best even before we started using it with Therenva’s EndoNaut. And EndoNaut is very helpful for surgeons. The systems complement each other perfectly.” Prof. Dr. Kaladji sees the advantages of image fusion for other fields as well: “In the future, image fusion will also be important for cardiologists, especially for TAVI interventions, for example,” says Prof. Dr. Kaladji. TAVI stands for ‘transcatheter aortic valve implantation.’ In this procedure, the biological heart valve prosthesis is implanted using a minimally invasive method. Prof. Dr. Kaladji is convinced “that image fusion will be as useful to surgeons in cardiology as it is to me in vascular surgery.”

Acquired at
TAYS University Hospital,
Tampere, Finland, by
Dr. Aimo Miettinen using
a Ziehm Vision RFD 3D

Image of the year

The most common rheumatic disease in children under 16 is juvenile arthritis. This autoimmune disease attacks the synovial membrane and can damage patients' cartilage, bones, tendons, and ligaments. Medication is usually the treatment. However, deformities caused by the disease often require surgical correction.

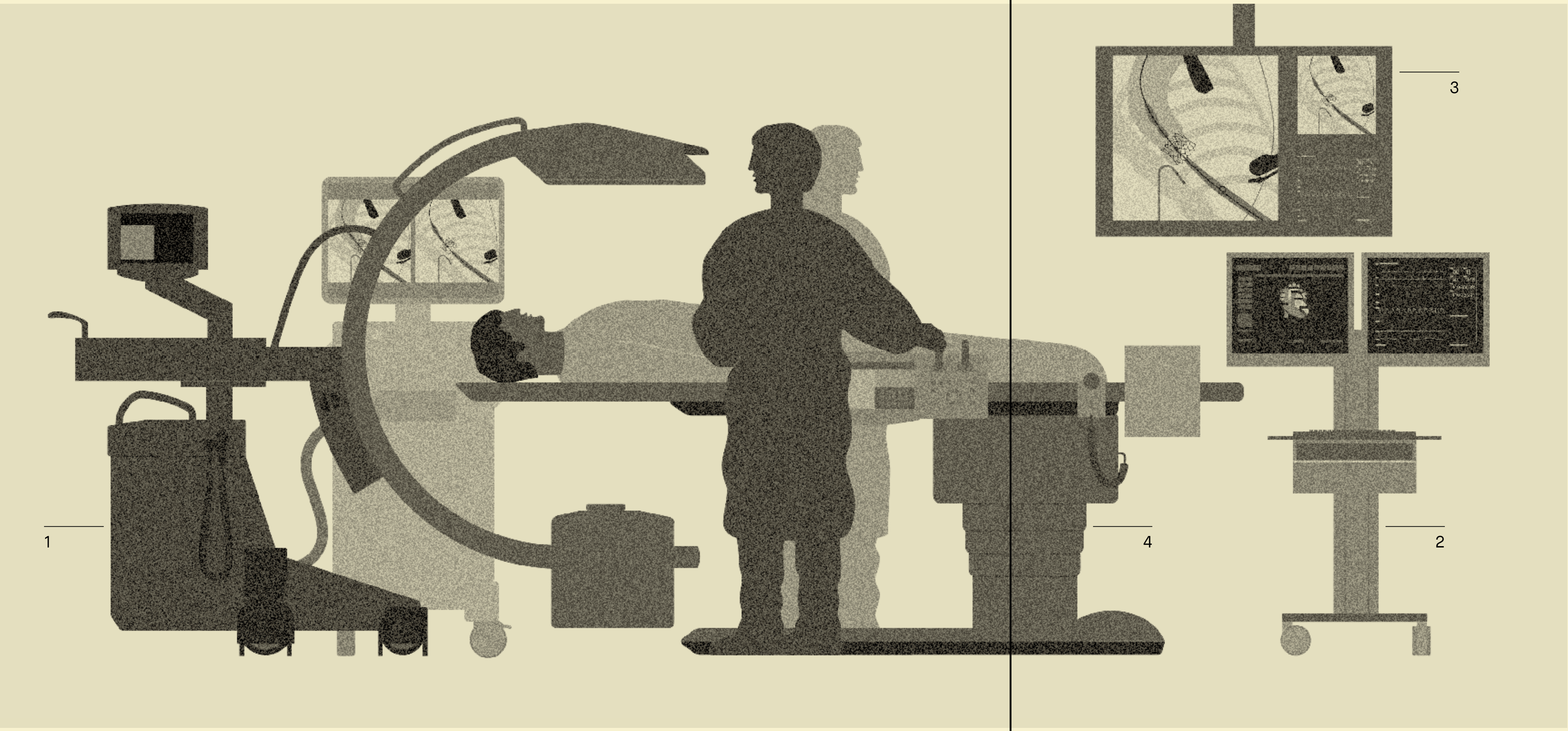
In this patient, born in 1984, both temporomandibular joints were destroyed by the disease, and the lower jaw was retrognathic. The surgery included an implant for both temporomandibular joints, a LeFort I osteotomy for the upper jaw, and a genioplasty. The surgery was virtually planned based on a CT data set. During the surgery, the Ziehm Vision RFD 3D provided support with innovative 3D technology. This enabled the physician to view the relevant tissue at the outset using 3D images and to identify the correct site for the incision. Final 3D images ensured the correct positioning of the implants.



What distinguishes a mobile cardiac catheterization laboratory?
Mobile CathLab equipment is similar to that of a conventional cardiac catheterization laboratory. In addition to a powerful C-arm and a reliable hemodynamic measurement system, various monitors for displaying images and a radiolucent table are essential for good performance and care.

The mobile CathLab

The average age of the global population is rising. The number of cases of cardiovascular disease, which is still the leading cause of death worldwide, is, therefore, also on the rise. This makes it even more important for physicians to perform corresponding minimally invasive procedures simply, efficiently, and safely. Multifunctional hybrid cardiology solutions such as the mobile CathLab are a real alternative to typical cardiac catheterization laboratories. Mobile cardiac catheterization laboratories can be used anywhere and at any time. They are noted for their lower acquisition and installation costs and a faster return on investment. At the same time, they deliver uncompromised clinical effectiveness.



1

Powerful mobile imaging for recording cardiovascular moving images

During cardiac imaging procedures, moving images must be displayed clearly. In order to acquire high-quality fluoroscopy images, a mobile C-arm is ideal, as it can be controlled by the user. At the beginning of the examination, the user can record a short video of the affected vessels and document the status for analysis, in order to assess the results afterwards. The physician usually uses additional contrast media for better visualization and interpretation of vessels and cardiac structures. Images in real time are also necessary when inserting and positioning catheters, as this helps prevent complications, among other things. In addition, it's necessary to create another video sequence after the procedure so that modifications can be carried out immediately if necessary. This analysis can prevent the need for a follow-up intervention for the patient. Thanks to the flexibility of the mobile C-arm, any operating room can be used as a mobile CathLab without much effort or additional costs. The C-arm is rolled into the operating room, connected to the power supply, and is immediately ready for use. This allows a faster return on investment (ROI) compared to a fixed system. When choosing a C-arm for a mobile cardiac catheterization lab, the focus should be on image quality and generator power. Detailed and clear moving cardiac images are created by short, high-energy pulses that reduce motion artifacts, and high contrast imaging. This is where the Ziehm Vision RFD Hybrid Edition Cardio CMOSline, with the most powerful generator on the market, proves its worth. The 30 kW[4] generator power provides the best possible support for imaging fine wires, catheters, and electrodes. This enables the device to perform clinical procedures such as coronary angiography, and electrophysiological interventions, as well as complex procedures for the treatment of structural heart disease, such as TAVI, mitral valve clipping, and occluder implantation. A self-regulating cooling system ensures a constant operating temperature and continuous, reliable operational readiness of the C-arm.

2

Efficient and space-saving monitoring and recording

The control room is an important part of every cardiac catheterization lab. In the mobile CathLab, a hemodynamic measuring station replaces a conventional control room. During a cardiovascular exam, continuous recording of the cardiovascular system is required. Monitoring the cardiovascular system and the analysis of cardio function with the help of the measuring station guarantees patient safety during the procedure. The measuring station also simplifies protocol creation for the user and generates the final report, which can be stored in the corresponding image or communication archiving system and in the electronic patient file. Ziehm Imaging's mobile CathLab solution relies on the QMAPP mobile hemodynamic measurement station from our Dutch partner Fysicon, which brings all relevant parameters together in a single front end. Freedom of movement in the OR is increased by the mobile, compact amplifier that can be connected to the operating table with a single cable.

3

Simultaneous display of cardiovascular images and vital signs

Viewing relevant cardiac images in high quality during surgery is very important for cardiac procedures. While there is no need for additional image displays aside from the classic monitor cart that comes with the C-arm, an additional ceiling or wall monitor provides maximum flexibility and can increase efficiency. The additional monitor should be clearly visible to the operator to allow simultaneous viewing of pressure values and ECG data transmitted from the hemodynamic measurement station. It should also be able to display real-time fluoroscopic images acquired from the C-arm and stored reference images. This requires both a stable transmission connection and technology that displays real-time data in high quality. In modern cardiac catheterization laboratories, due to the high number of displays needed, a single large monitor is usually used that can display images from different sources in separate windows. Image sequences can be transmitted from the C-arm to the external monitor as a live signal via the wireless interface. Wireless transmission reduces the risk of tripping over cables, the user can position the medical equipment where it is needed, and additional hard-to-clean plugs and sockets are avoided – an important hygiene aspect. For displaying various image signals in the mobile cardiac catheterization laboratory, Ziehm Imaging recommends a 55" UHD monitor, which supports up to twelve input signals and can display all vital signs and other image signals simultaneously in addition to the real-time images.

4

Radiolucent, mobile, and free-floating operating table

A radiolucent imaging table enables complex interventional procedures. Care should be taken to ensure that the table has smooth, rounded edges. This prevents motion artifacts that can occur especially with angled images, i.e., images in oblique projection. If the table has a free-floating mechanism, it can be flexibly controlled by the user. A mobile table can also be quickly moved to another operating room at any time, completing the mobile CathLab setting. These requirements are met by the STILLE imagiQ2, which has a record setting of radiolucency for mobile imaging tables: up to 60% more translucency than conventional fluoroscopy tables.

Photos
Iona Dutz

Synergies

The ongoing development of medical devices depends on cooperation between healthcare professionals and industrial developers. Prof. Dr. Christoph Josten tells us more about the role and trends of mobile imaging in trauma surgery at Leipzig University Hospital and about collaboration with Ziehm Imaging in these areas.

Professor Josten, what do you think sets the University Hospital in Leipzig apart?

Leipzig University Hospital is the second oldest university hospital in the German-speaking world. It has a very good reputation, which is also reflected in recurring awards. Eight years ago, I was faced with the challenge of merging the specialties of orthopedics and trauma surgery. I succeeded in building the Clinic for Orthopedics, Trauma Surgery and Plastic Surgery into one of the major university institutions in Germany, both in terms of patient numbers and the medical spectrum. The university hospital is certified as a Level 1 trauma center and has the highest level of certification as an endoprosthetics center as well as in spinal surgery. In addition, the clinic has very modern structures. The position of clinic director is not for life, as is common at most other universities in Germany. The executive director is elected by the five equally appointed professors of the Trauma Surgery, Orthopedics, Spine Surgery, Arthroscopy Sports Medicine, and Plastic Surgery departments on a regular basis, which strengthens the team spirit. I am proud that we have done so well in Leipzig so far.

Before you became medical director of Leipzig University Hospital, you worked in trauma surgery for 40 years. What is so appealing to you about this specialty?

Patients are often in life-threatening situations. You have to be able to make decisions quickly, and have good, broad-based medical knowledge and manual dexterity. I have never regretted my decision to become a trauma surgeon because of this fascinating combination.

What role does imaging play in trauma surgery?

Optimum imaging is indispensable in trauma surgery and an essential component of quality. Good, sharp images are important for making a diagnosis. But good imaging is also essential during the procedure to objectively assess surgical steps. After, or better, during the operation, good images can be used to check if the surgeon is satisfied with the result or whether he needs to make further adjustments.

Why did you decide to use a mobile C-arm for imaging?

I'll try to explain it like this: If I can get a car with four-wheel drive, I'll take it. Since the 1980s, when the first mobile C-arm from Ziehm Imaging came on the market, it has been part of my daily surgical routine. Before that, when there was a fracture, usually an X-ray assistant had to come from the X-ray department. Many of those involved in the operation left the room, while some, protected by lead vests remained with the patient. X-rays were taken and stored on a cassette. Worst case, this then had to be taken to the radiology department. It could take up to 15 minutes to get an image, which was sometimes underexposed or blurry. Intraoperative imaging has greatly improved this process. The mobile C-arm is brought into the OR, the images can be taken right away and displayed on the monitor.

For a long time, 2D images were common in intraoperative imaging. Especially in orthopedics and trauma surgery, 3D imaging has been gaining in importance for years. What advantages does a three-dimensional image offer?

We were one of the first pilot clinics to work with 3D technology in imaging when it entered the market. It was like watching a movie with 3D glasses today. Thanks to the three-dimensionality, you dive into the anatomical structure in much more detail. With two-dimensional X-rays, you only see two planes. In between, however, there are umpteen degrees of angles that obscure something or that cannot be visualized properly. To get a usable image, you would often have to take countless X-rays. With the 3D scan, there is much less X-ray exposure and anatomical structures are much easier to see. This has helped me enormously, especially with complex fractures, to better understand the fracture and repositioning mechanism on the one hand and, of course, on the other, also to check the result after the operation. The 3D image is much more informative and meaningful because you can see all the levels of the joint and additional levels that are easier to miss in a 2D image. In my opinion, the advancement in 3D imaging has brought a huge increase in knowledge and a significant improvement in the quality of care.

You mentioned intraoperative control with the help of a 3D scan. How has this helped you with your work as a trauma surgeon?

I was one of the first trauma surgeons to argue that intraoperative 3D control should become a must. It gives you the opportunity to assess the outcome before the end of an operation and thus prevent follow-up surgical procedures, including anesthesia. After all, how do you explain to a patient at the X-ray check the next day that the surgical result is not optimum?

Prof. Dr. Christoph Josten, specialist for surgery, orthopedics and trauma surgery/special trauma surgery is currently the medical director at the University Hospital Leipzig. He manages all medical, organizational, and legal tasks as well as the cooperation between the various medical disciplines and with external partners. Previously, he worked in surgery for over 40 years, most recently as managing director of the Clinic for Orthopedics, Trauma Surgery and Plastic Surgery at the University Hospital in Leipzig, where he also taught.

That he must either accept the result with all its consequences or agree to another operation? Another argument in favor of intraoperative 3D scanning is the very good image quality. In the past, especially with complex fractures, repositioning maneuvers, and osteosyntheses, a postoperative CT scan was often necessary to check the result of the procedure. Today, 3D imaging is often so good that there is no longer any discernible difference in quality. In addition, the significantly lower radiation exposure benefits both the patient and the user. In my opinion, intraoperative 3D imaging is now an indispensable part of any advanced trauma surgery or orthopedics OR.

How do you think 3D imaging will change in the future?

If the focus of imaging systems is on the quality of imaging, reduction of radiation exposure, as well as ease of handling, and this is expanded to include digitally networked systems, there is enormous potential for development. In the future, it may also be possible to better image soft tissues and vessels. I still see potential in these areas to enable the progress of medical specialties beyond trauma surgery.

It is also possible to perform navigated procedures with C-arms from Ziehm Imaging. How important was navigation to you during operations?

I was a fan of navigation from very early on. I started doing CT-based navigation about 20 years ago. At that time, it was still very cumbersome, raised a lot of questions, was time-consuming and not of sufficient quality.
I decided at that time to wait for further progress in the technology. When image intensifier-based navigation came on the market in the mid-2000s, I started again, and I quickly realized that the development was a quantum leap. The advantages of 3D imaging that we just discussed could then be combined with navigation. The accuracy was excellent. From then on, it was possible to perform far more minimally invasive surgeries and reduce surgical dimensions. On top of that, the image size expanded thanks to the introduction of the flat panel. With the larger images, it was possible to navigate well and safely in more complex, larger body regions. Since then, it has been a must for me to perform certain procedures with navigation. One needs significantly fewer postoperative control CTs, since the 3D images obtained intraoperatively with the mobile C-arm from Ziehm Imaging offer good image quality. Nevertheless, in my opinion, it is important to be able to master the surgical challenges without navigation and to be technically versed in the surgical repertoire so that it's possible to operate without navigation at any time if necessary.

How do you see the market for navigation and robotics?

We, as a hospital, are sure that the advances in imaging, navigation, and computer-assisted surgery are unstoppable, as they lead to a huge improvement in the quality of many invasive procedures. That's why we established the 'Center for Computer Assisted and Navigated Surgery' last year. We are also getting three state-of-the-art operating rooms this year, which will be equipped with the latest CT and 3D-assisted navigation systems. The quality standards of surgeries are so high that without such systems it is no longer possible to meet the demands of today's high-tech medicine.

Do you think navigation will continue to gain in importance in the future?

You can compare developments in this area with road traffic. In the past, many people claimed that they didn't need a navigation system in their car because they had a strong sense of direction. Today, almost no one drives without one. People know that they might not need it every day, but if the route is unknown or they are looking for the fastest route, they inevitably fall back on navigation. It's the same with navigation in the operating room. That is why I believe that there is still potential in many areas where it is not yet considered today. Since navigation systems deliver an improvement in quality, they will become even more important.

Let's take another look at the past. When and why did you decide to work with Ziehm Imaging fluoroscopy systems?

It was so long ago that I can't really say – certainly more than 30 years ago. I noticed Ziehm Imaging mainly because the equipment was much handier than others on the market. Since space in the operating room is usually very limited, this criterion was and remains important. In addition, Ziehm Imaging offers user-friendly fluoroscopy systems. But of course, the very good image quality is the main thing. I'm also convinced by the good operability, the easy maneuverability, and space-saving.

You have worked a lot with Ziehm Imaging in recent years. What can you tell us about your collaboration?

When an innovative company like Ziehm Imaging meets physicians who are interested in new developments, a constructive collaboration almost inevitably results. In my experience, Ziehm Imaging is very open to feedback from physicians about their systems and the resulting needs and wishes. At an early stage, we decided on development projects with Ziehm Imaging and conducted clinical and anatomical studies to find out, for example, how to improve image quality and reduce radiation exposure at the same time. A trusting and result-oriented collaboration like this gives rise to new projects, such as systems that will ultimately be launched on the market for the benefit of the patients.

What added value do you see in working with Ziehm Imaging?

For me, the most important aspects in my direct collaboration with Ziehm Imaging were the technical progress as well as the practice-oriented applicability and, ultimately, the benefit for the patient. On the other hand, the international contacts that were established through the collaboration and that then developed into global partnerships were also important. Guest physicians came from a wide variety of countries and were able to see the technical possibilities of the systems for themselves. We were able to train doctors here in Leipzig, which also led to an extensive medical exchange. This was very important, especially for me as a scientific university lecturer. These are all very positive aspects of the collaboration between medicine and industry. Not only are products developed that benefit the patient, but these products are also accepted internationally and scientifically. This contributes to the reputation of Germany as a center of manufacturing and science.

You are now the Medical Director of Leipzig University Hospital. How has your collaboration with Ziehm Imaging changed in this role?

Due to my current position, I no longer work personally with Ziehm Imaging. However, Leipzig University Hospital is still a partner. Of course, I monitor developments, keep in touch with medical colleagues and users, and make sure that they have the best possible equipment for the best possible therapy for our patients. And I hope that Ziehm Imaging will continue to dedicate itself to research and new developments in exchange with medical professionals, even without my specific involvement.

What opportunities do you see in the future for Ziehm Imaging's collaboration with Leipzig University Hospital?

On the one hand, the business relationship continues, as we have Ziehm Imaging equipment in our hospital. That means the cooperation will continue. But of course, I would also like to see scientific collaborations in the future with the colleagues who now run the Clinic for Orthopedics, Trauma Surgery and Plastic Surgery. I would also like to see companies getting involved in our new center for robot-assisted and navigated surgery. After all, establishing a leading international center for technically-assisted surgery can only succeed through good cooperation. Both sides must approach each other, i.e., the industry, the physicians, and the clinics must approach the manufacturers so that joint projects can be realized. That's why I'm sure that there will be fruitful cooperation in the future as well.

And finally, a look into the future: How do you envision the optimum clinical workflow in ten years?

My vision of a future surgical workflow could perhaps best be compared to autonomous driving. You sit in a car that drives itself based on navigation. It warns you when there is a risk of traffic jams, brakes automatically, and never drives too fast, so that the driver only has to intervene if he doesn't trust the automatic system or gets into an exceptional situation. Similarly, I can also imagine future interventions consisting of a combination of robotics and navigation. Certain surgical steps would take place fully automatically and surgeons would only have to intervene at critical points, and perhaps not even necessarily be on site in the operating room.

Photos
Page 48, 51: Simeon Johnke
Page 52: Juli Sing
Page 54: Steffen Hedderich

Theory and Practice

As one of the largest universities in Germany and Europe, the Ludwig Maximilian University of Munich (LMU) hospital is an important Ziehm Imaging partner. Based on experience of the daily use of mobile C-arms by clinicians in operating rooms, the systems are developed further in order to offer the best possible support for the clinical routine.

The continuous development of the mobile C-arms is essential for clinicians. New software and additional features can make operations even more efficient and safer for physicians and patients. For this reason, at Ziehm Imaging the users are involved in the development process as clinical consultants. They contribute valuable ideas and give feedback on innovations and stages of development. Alongside the benefit for everyday clinical work, the focus here is on functionality, ease of use and above all, safety for the users and the patients. After the development has gone through all the necessary processes, clinical verification takes place at the LMU hospital. If this is successful, the new development becomes available on the medical technology market. This cooperation is a key factor in driving innovation in the field of mobile imaging.

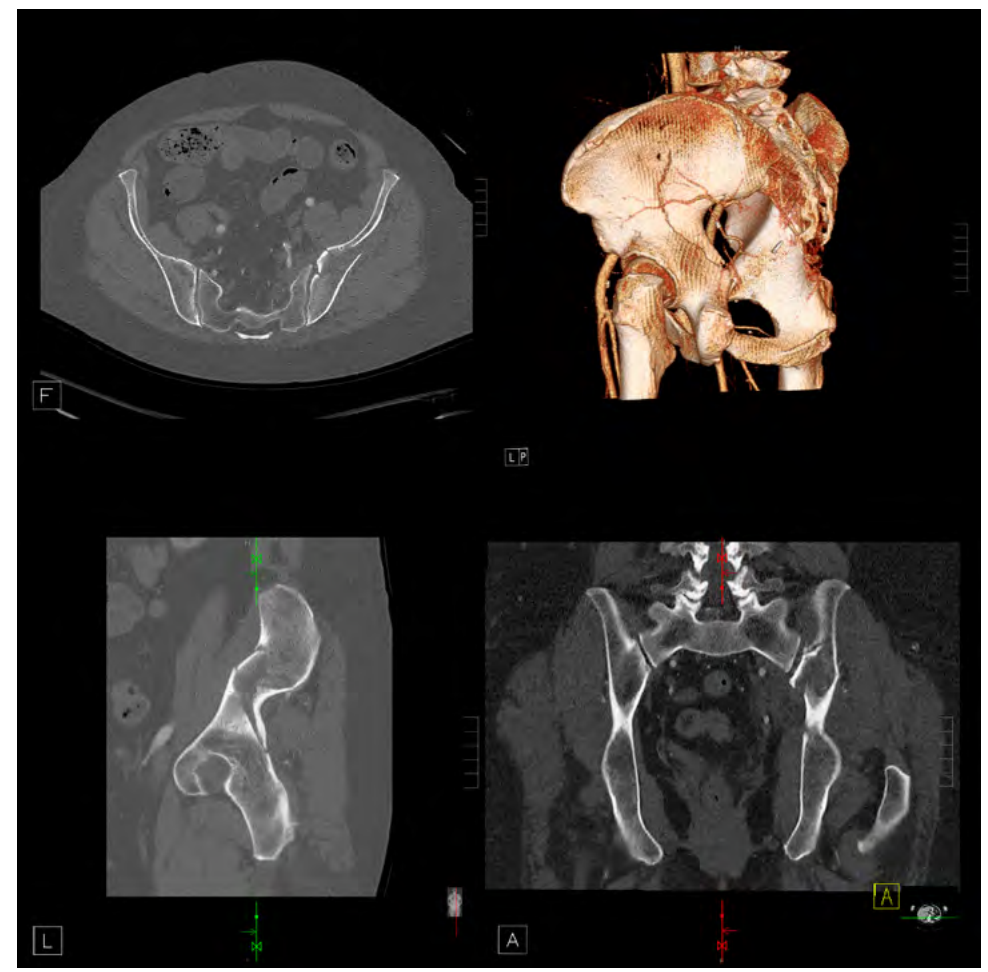
During a visit to the Ziehm Imaging Global Headquarters in Nuremberg, Prof. Dr. Wolfgang Böcker and Dr. Simon Weidert shared their experiences from their clinical routine, in which they use the Ziehm Vision RFD 3D with new software solutions. Alongside product-related discussions with the Product Management team, the Research and Development department and Global Sales and Marketing from Ziehm Imaging, the focus was on practical application. The corporate headquarters of Ziehm Imaging contains two demonstration ORs, which resemble conventional, fully equipped clinical ORs. It is possible to work with the Ziehm Vision RFD 3D in both of these rooms. After a demonstration of the new software development by Product Management, the doctors were able to operate the system themselves and try out various features. Cattle bones were used for suitable 3D test images. The discussion of advantages and disadvantages during application, as well as the usability in everyday hospital routine, represent important points of reference for the optimization of the system and the entire product portfolio.

Prof. Dr. Böcker, Director, Chair of Trauma Surgery (top) and Dr. Weidert, head of Vertebral Column department (bottom) from the LMU Hospital Munich Grosshadern test and assess the use of new, innovative software solutions using cattle bones as examples.

Below: The supraregional LMU trauma center is an important acute care clinic for severely injured patients in southern Germany.
Right: The conventional 3D CT images help with pre-operative planning.

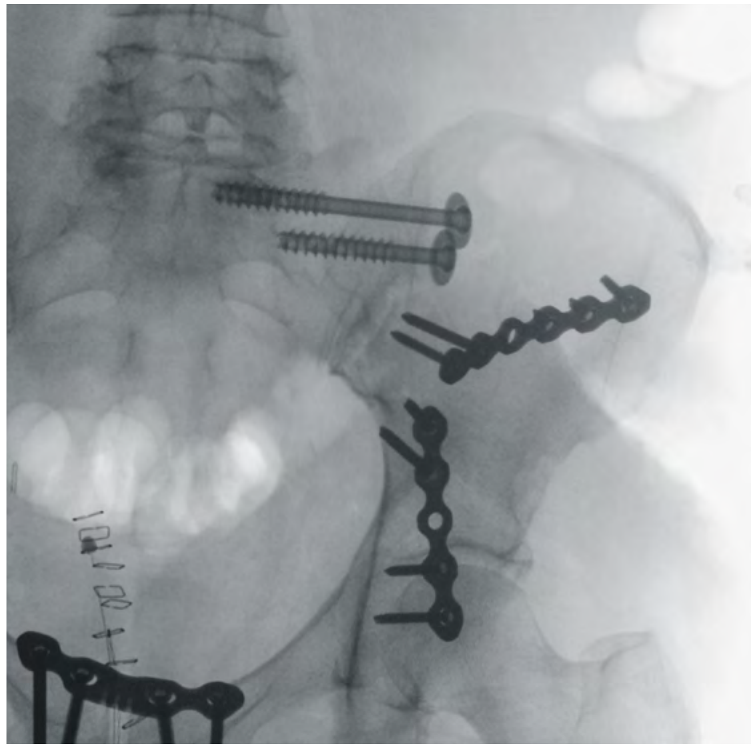
The Trauma Surgery department of the Musculoskeletal University Center Munich of the Ludwig Maximilian University is a supraregional trauma center and provider of severe injury type procedures. This area of focus thus represents an important pillar of medical care in southern Germany. In this field of medicine, a Ziehm Vision RFD 3D is used on the Grosshadern campus for the treatment of polytrauma, among other uses.

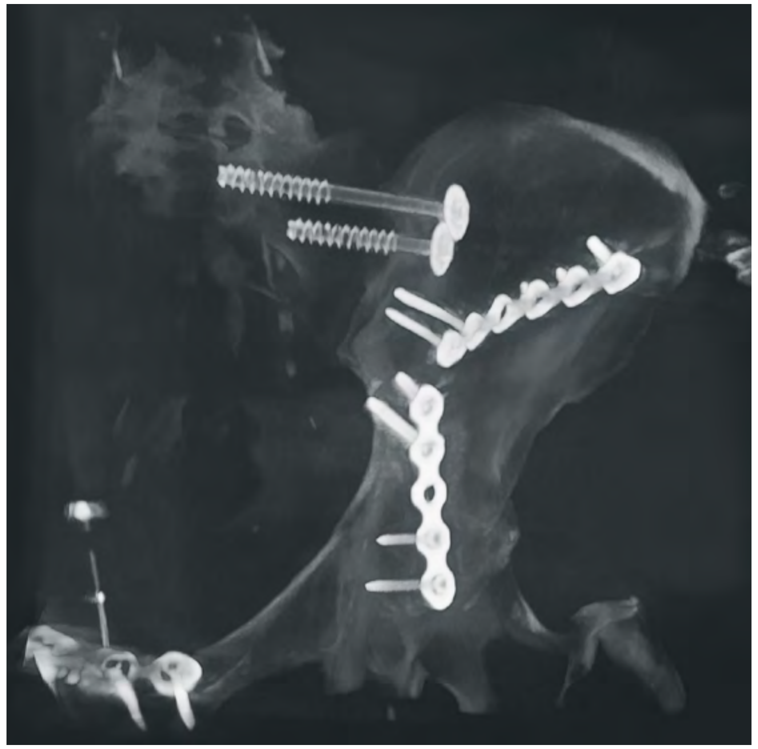
Recently, a 60-year-old woman was admitted to the hospital trauma room after a traffic accident. The woman's motor scooter had been hit at approximately 30 km/h by a car. She fell onto her left side. The pelvic ring fracture caused by the accident was treated surgically with several plate osteosyntheses and minimally invasive screw fixators. In spite of the patient's high BMI of 32, the Ziehm Vision RFD 3D provided good image quality, allowing the operation to be carried out without any problem.



In an initial operation, the symphysis was treated and the pelvis stabilized with a fixator. In the second operation (pictured here), Prof. Dr. Carl Neuerburg, deputy clinic director and head of Trauma Surgery, carried out treatment of the left wing of ilium and the SI joint disruption. Initially, a 2D image was acquired to verify the initial situation. In order to stabilize the wing of ilium in two places and the SI joint disruption with angle-stable plates, Prof. Dr. Neuerburg worked with 3D scans. The three-dimensional display of the anatomy made it possible to conduct the operation more precisely and simultaneously reduce the dose. Using 2D images, the position of the installed plates and screws was subsequently verified to ensure that they were optimally positioned. This made it possible to avoid revision surgery.

Left: Prof. Dr. Neuerburg, deputy clinic director and head of Trauma Surgery at the LMU Hospital, during the operation on May 6, 2022.
Below: During the osteosynthesis of the left ilium, a Ziehm Vision RFD 3D was used. The left side of the pelvis is clearly visible here, with the installed screws in the caudal section and the final installed plates on the left.





1 / page 15
Ziehm Vision RFD Hybrid Edition represents a group of optional hardware and software that creates an option package on the device named Ziehm Vision RFD.

2 / page 22
Ziehm Imaging is the official Sales and Service representative for Orthoscan mini C-arms in Europe, the Middle East, and Africa

3 / page 31
CMOSline represents a system configuration that is based on a Ziehm Imaging CMOS flat-panel detector.

4 / page 40
The 30 kW generator is available in combination with dedicated cardio packages.

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Ziehm Imaging is specialized in the development and manufacture of mobile C-arms. For more than 50 years, we have produced technologies that enhance imaging and streamline clinical workflows. The mobile X-ray devices’ exceptional image quality and flexibility in the operating room serve as an important basis for treatment success.