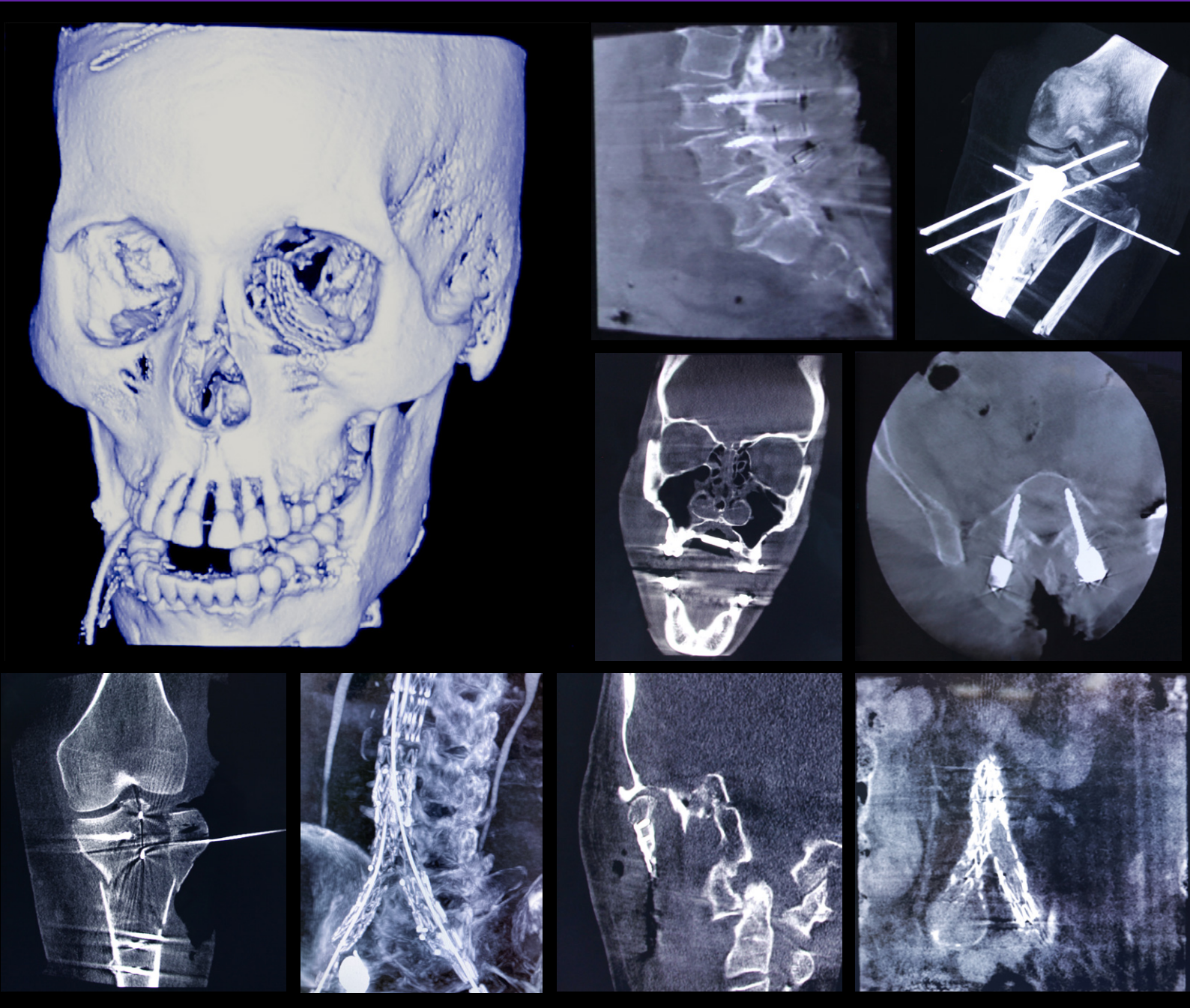
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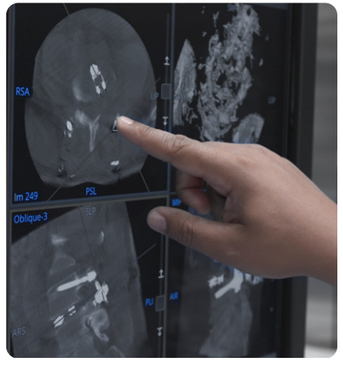
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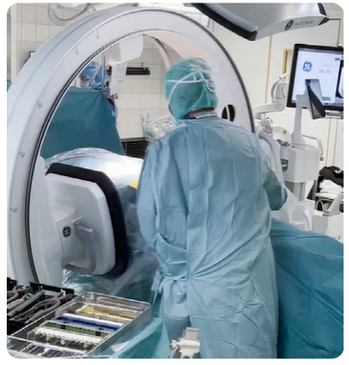
#05

Innovation in Surgical Imaging with OEC C-arms



OEC Magazine











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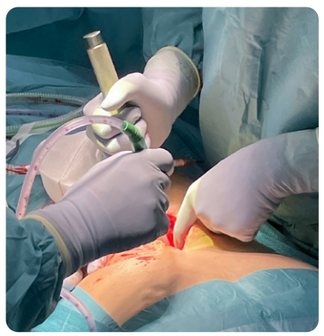
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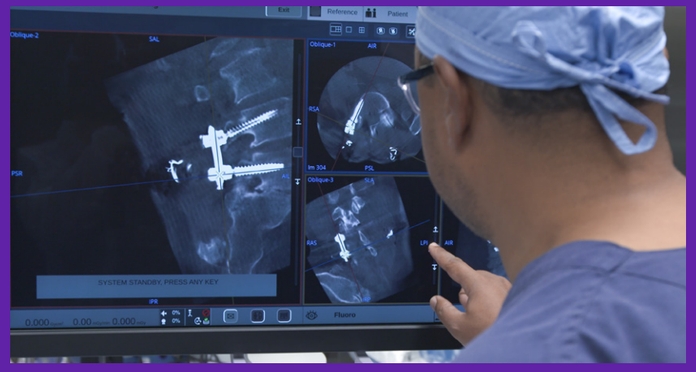
Spine surgery

Minimally Invasive Outpatient Spine Surgery with OEC 3D

Interview with Dr. Ernest E. Braxton, Jr. Neurosurgeon at Vail-Summit Orthopaedics & Neurosurgery in Vail, Colorado, United States.

Vail-Summit Orthopaedics and Neurosurgery is a 13-physician group practice specializing in musculoskeletal care, sports medicine, joint reconstruction, spine surgery, as well as physiatry and rehabilitation.





Focused on minimally invasive spine surgery, Dr. Braxton has more than 13 years of experience. Before joining Vail-Summit, he was the Chief of Neurosurgery for the Air Force in San Antonio, Texas. Dr. Braxton has extensive experience in the military serving in tertiary medical centers like San Antonio Military Medical Center, Wilford Hall Medical Center, and on military deployements in Korea, Germany, and Afghanistan. Dr Braxton shares his experience performing minimally invasive outpatient spine procedures and how he has fully incorporated the OEC 3D into his practice in Vail, Colorado, U.S.A.

Why minimally invasive outpatient spine surgery?

I started my career doing about 60% cranial work, skull-based work, tumors, cerebrovascular and about 40% of spine, mostly complex spine and in trauma situations. Then, I made a little pivot towards minimally invasive spine with an emphasis on outpatient surgery. There are a lot of similarities between the population that I see here in Vail and in the military. They are for the most part, very healthy, active, and motivated patients, looking for a quick recovery. It seemed to make more sense to perform minimally invasive operations where there is less tissue disruption and do the procedure in a way that it could be outpatient. The COVID pandemic really highlighted that and was an accelerant to helping us do more outpatient surgeries because we needed the hospital beds to reserve them for higher acuity patients. Yet, patients with elective degenerative problems really wanted to get their procedures done, and in an outpatient setting where they can recover at home.

Why did you choose the OEC 3D for your practice?

We did an exhaustive search trialing and looking at other C-arms. At the end of the day, one of my concerns was what is the long-term durability of the product? What if the technology shifts or moves, will this C-arm still be competitive? Will this still meet my surgical needs for my patients?

The fact that the OEC 3D is open source, it means that you can apply many different types of implants and technologies. This gives me, as a surgeon, a lot more options when discussing alternatives with a patient.*

What type of procedures are you using the OEC 3D C-arm for?

The OEC 3D has really been a game changer in my practice. We use the OEC 3D for artificial disc replacement surgery, both in the cervical and lumbar spine, spine arthrodesis or spine fusion operations, for lumbar discectomy and laminectomy, as well as neuromodulation cases where implanting spinal cord stimulators.

> *"OEC 3D really takes the place of a traditional C-arm because it does everything that a traditional C-arm does, plus it can render 3D reconstructed images for more precise localization."*

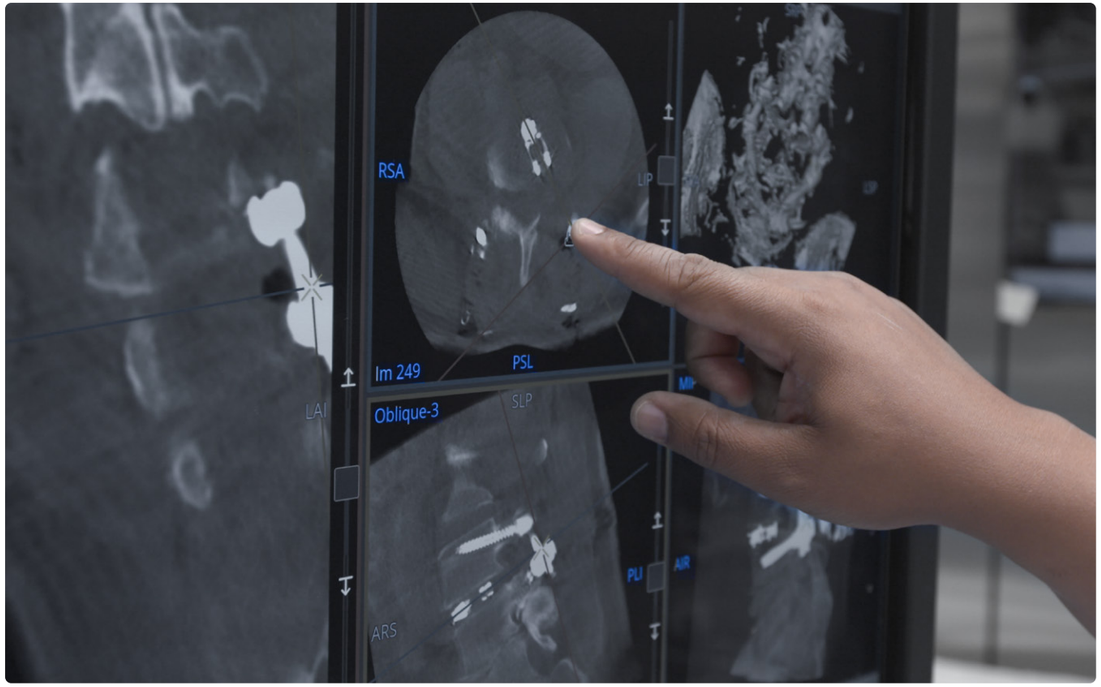
One of the more challenging cases we do is localizing in the thoracic spine. We don't have the same landmarks as in the cervical spine or lumbar spine, and when I'm doing thoracic procedures, I find the OEC 3D a must have device. In fact, we make it a note that the OEC 3D needs to be in the room, or we don't do the case. Having the large field of view and being able to get a 3D reconstruction when you're in the thoracic spine is critical.

The OEC 3D has a small footprint and less radiation exposure: We're not leaving the room to do a spin or a 3D reconstruction, and when it is not necessary to do a 3D reconstruction, we use the OEC 3D as a conventional C-arm, with a large field of view.

How does the OEC 3D improve your workflow?

I thought the OEC 3D was a conventional C-arm. I didn't realize that it had the ability to obtain 3D reconstructed images of the spine for surgery. The OEC 3D offers different methods of imaging specific anatomy, and it has features that I wasn't used to having but found to be invaluable, like the Live View camera and the green laser aimer.

> *"Image quality has really been amazing, both in the image quality itself and the large field of view."*



Review of spine images on OEC 3D Volume Viewer.



Dr. Braxton preparing for a 3D acquisition using OEC 3D assistant for collision check.

Specifically during neuromodulation case or spinal cord similar case, where the precise localization of your leads is critical to the outcome of the surgery.

With other traditional C-arms, what we had to do was to take a shot and then move the detector along as we were driving the lead along the spinal cord.

What has changed our workflow in multiple ways is the 3D acquisition time. When I was using other devices, often we would skip the post-op spin because of radiation exposure to the patient and added surgical time. Now, with the OEC 3D system, we do pre and post-spins for every case because the imaging is superb, the timing is quick, then the question is, why wouldn't you get a second spin?

When placing an artificial disk, unlike a conventional fusion operation, it's important to know exactly where you are, to be precisely in the midline and make sure that the prosthetic fits the patient perfectly. With the OEC 3D, having the capability to get a 3D spin, we're able to get better matches of the prosthetic and the patient anatomy, and know before leaving the operating room that the prosthetic is well placed.

The OEC 3D augmented what we already can do, because at the end of the day, we really need to know in real time where we're at anatomically. Navigation provides us a picture of the spine, in my case, 20 minutes or an hour ago; then, when I need to refresh that, getting a new spin or refreshing that image can be done in less than 3 minutes.

> *"Having the OEC 3D has given me more confidence to do complex procedures in the ASC (Ambulatory Surgery Center)."*

OEC 3D enables us to check the precise location of the instrumentation prior to closing, and because of the efficiency, the OEC 3D has allowed us to do more cases.

Why choose the OEC 3D over other C-arms?

One of the first things I noticed when comparing the OEC 3D to other 3D C-arms is the smaller footprint, the speed of image acquisition, and decreased radiation exposure, both to the patient and to the surgical team.

My favorite feature is the motorized position memory recall. When I line up a view to a pedicle or a specific part of the anatomy, I'll ask the technologist to save that shot, save that position, and then I'll go to another position. Later, the technologist can automatically go back to the last position quickly and easily. That is one of the biggest frustrations that we had before having the OEC 3D, finding that last view that we had 10 minutes ago.

> *"One of the first things I noticed when comparing the OEC 3D to other 3D C-arms is the smaller footprint, the speed of image acquisition, and radiation exposure management tools."*

Initially, I was concerned about not being able to physically move the C-arm around the patient and about the learning curve that would take for the technologist, myself, and our surgical team to use the device. But I found there's a lot of advantages to having a motorized C-arm, being able to memorize certain positions and coming back to those quickly, has really made my operations efficient.

What advice would you give to other surgeons that are purchasing a 3D C-arm?

If there are surgeons who have reservations about considering the OEC 3D C-arm, especially in an ASC, I would highly encourage them to do a trial of the device to see if it meets their needs for image quality. I think they'll find that it's a fiscally responsible decision, and it is a lighter footprint, smaller device to use in sometimes crammed operating rooms in surgery centers.

I can't really think of a procedure where I would not want to have the OEC 3D. We have really fully incorporated the OEC 3D into our practice. n



Dr. Ernest E. Braxton Jr. is a board-certified neurosurgeon who focuses on treating brain tumors, neurotrauma, and performing complex minimally invasive spine surgeries in the ambulatory surgery center. He is particularly enthusiastic about minimally invasive spine surgery due to the rapid recovery of patients.

*OEC Open is the OEC 3D C-arm interface designed to transfer 3D reconstructed volume data set to navigation or robotic systems.

Dr. Ernest Braxton is a paid consultant for GE HealthCare and was compensated for his participation in this testimonial. The statements by Dr. Braxton described here are based on his own opinions and results that were achieved in his unique setting. Since there is no "typical" hospital and many variables exist, i.e. ambulatory surgery center size, case mix, etc. There can be no guarantee that other customers will achieve the same results.

First experiences in Spine Surgery with 2D and 3D intraoperative imaging

With OEC 3D

Dr. John Pak and Dr. Dan Christensson, consultants in spine surgery, provide their perspectives on OEC 3D, illustrated through their experience during a case of spine arthrodesis.

The hospital of Halmstad from the county of Halland is located on the southern west coast of Sweden that offers beautiful nature comprising of beaches, forest and lakes. Serving the county to population of 300,000, Halland Hospital Halmstad offers a full range of specialized care to the population. Thus the orthopedic clinic of Halland Hospital Halmstad has developed a unit dedicated to spine surgery which launched the process of evaluating mobile C-arms for 2D and 3D intraoperative imaging.

The main motivation for the acquisition of a 2D/3D mobile C-arm is to obtain, in addition to traditional 2D images, comprehensive 3D volumetric images in the operating room for intraoperative clincial decision making. The team also wanted to assess the possibility to streamline the patient's pathway by eliminating the postoperative CT scan confirmation, based on the 3D imaging control performed in the operating room at the end of the intervention.



Spine surgery

3D Imaging Every Day

The OEC 3D is a true 3D/2D C-arm with the flexibility to acquire both precise 3D and 2D images without switching systems. Transitioning quickly and easily provides greater efficiency and versatility for a wide range of clinical applications from spine and orthopedics.

Precise Images

The OEC 3D enables allows to see more levels during a spinal fusion, or more of the pelvis or femur during an orthopedic procedure. With a 19 cm x 19 cm x 19 cm volume, OEC 3D captures a 67% greater volume than other 3D C-arms*.

The 3D acquisition designed for capturing as much data as possible is critical in creating highly detailed images. The OEC 3D delivers a true 200° isocentric orbital sweep, 35° more than other 3D C-arms*, for comprehensive 3D volumetric images.

The OEC 3D leverages GE Healthcare's proven AW image fabric technology to provide a premium 3D imaging experience. Analyze images with the Volume Viewer suite of 3D imaging tools including Multi-Oblique Mode, viewing all five image perspectives (Axial, Sagittal, Coronal, Volume Rendering, Maximum Intensity Projection) through all 512 slices, window leveling, zoom, and more.

*Compared to other 3D C-arm published specifications.

L4-S1 fusion by posterior approach with 2D and 3D imaging

Courtesy of Dr. Nils Petter Fossland and Dr. Mats Säll, St Olavs University Hospital, Trondheim, Norway

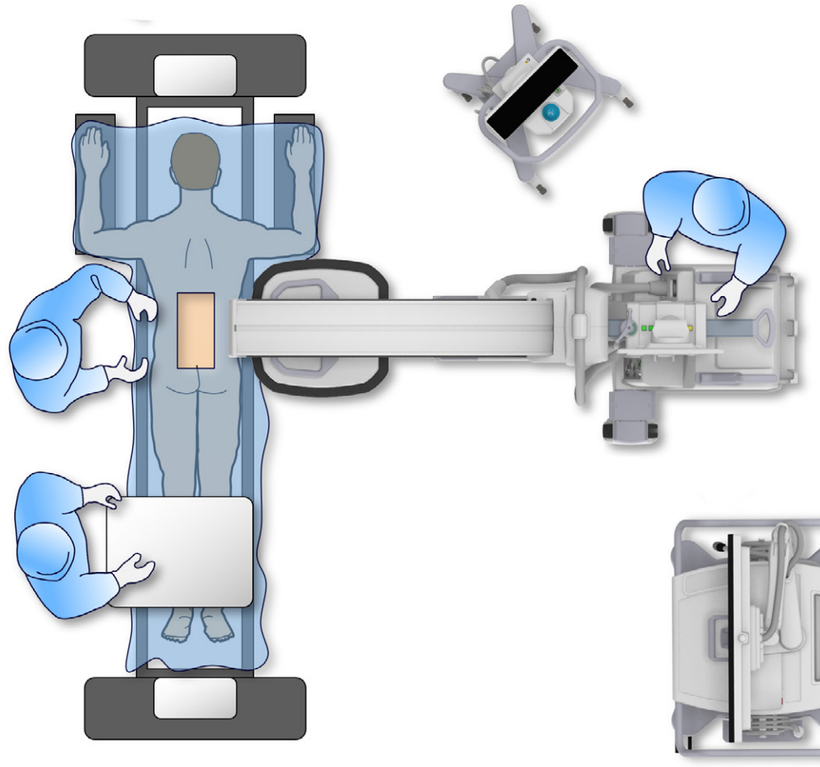
Patient and C-arm Set up

Patient is positioned in prone. The C-arm is placed perpendicularly to the patient table.





Operating room set-up for spine 3D images acquisition

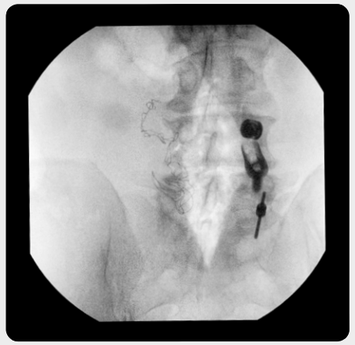


2D intraoperative imaging

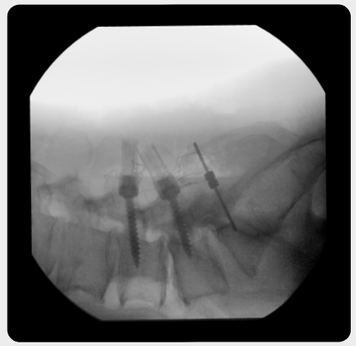
Anatomical imaging profile is set to Spine. Fluoroscopy mode is set to standard continuous. A first fluoroscopic image is taken to confirm the vertebral level to treat. Further 2D imaging centering is done using the Live View camera of C-arm to limit the number of image acquisition and manage dose radiation level.



Lateral view – definition of incision level on L4



Antero Posterior view



Lateral View

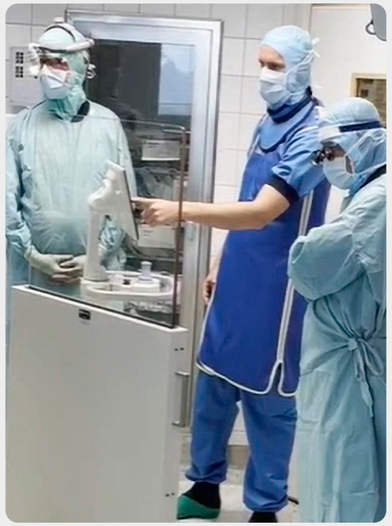


Antero Posterior View

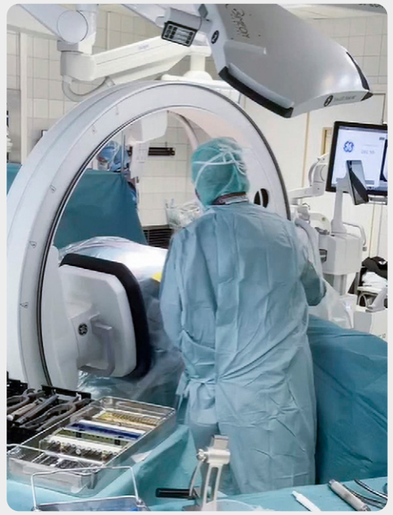
Once all the pedicle screws are placed, surgeons proceed to the 3D acquisition on L4-S1 to control the overall surgery on volumetric images.

3D imaging final control with Setup Assistant

The Setup Assistant guides the user through 4 steps to acquire the 3D scan. After setting the 3D imaging plan and centering the anatomy in the 3D volume, the Setup Assistant allows the user to check that the C-arm rotates freely around the patient.





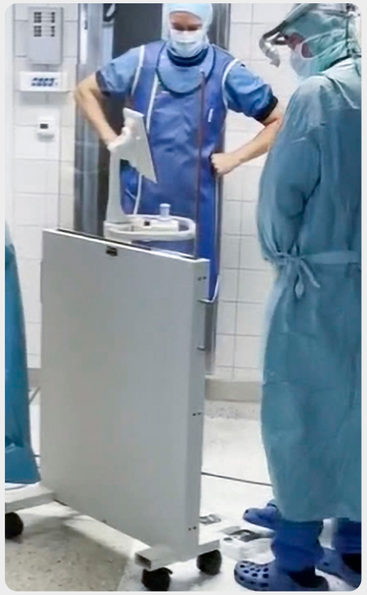


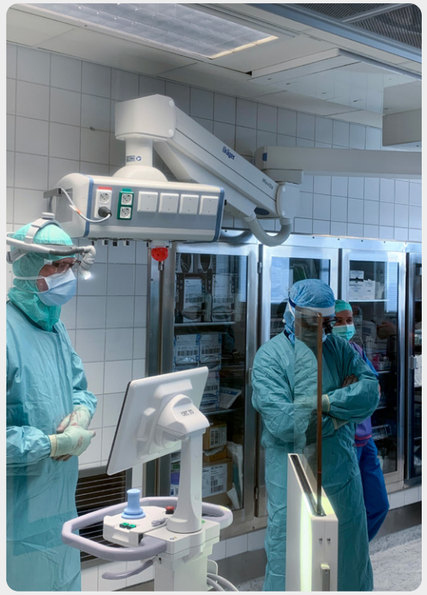


Once the collision check is complete, the system can start the 3D scan. The C-arm rotates 200° during a scan and takes the projections. The scan time is typically 30 seconds.

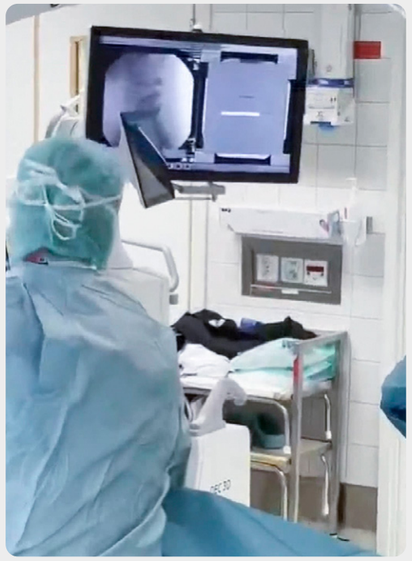
“I could make the operation with quick and easy 3D imaging”

Dr. John Pak





3D scan acquisition from wireless pedal footswitch



At the end of the 3D scan, the data set is reconstructed and presented on displays for viewing in the Volume Viewer for precise analysis of 3D perspectives.

“I feel more confident to precisely control the position of the screws in the vertebral pedicles before closing the patient. It helps me to assess the quality of my surgical gesture to avoid revision surgery.”

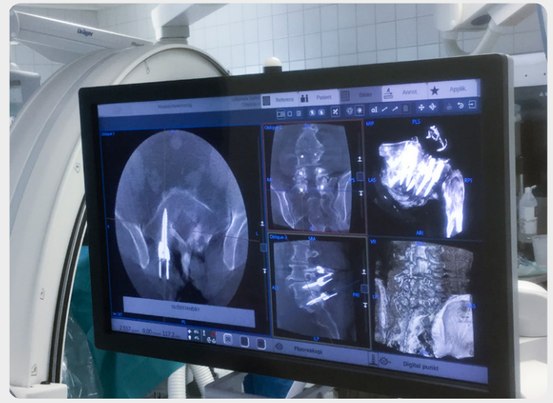
Dr. Dan Christensson

The Volume Viewer presents high resolution 3D images, from the 19 cm x 19 cm x 19 cm volume, in five perspectives.

The volume visualization is based on AW image fabric technology to provide a premium 3D imaging experience. User an analyze images with the Volume Viewer suite of 3D imaging tools including Multi-Oblique Mode, scrolling through all slices, window leveling, zoom, and more.









Each view can be placed on the left side for larger format visualization.

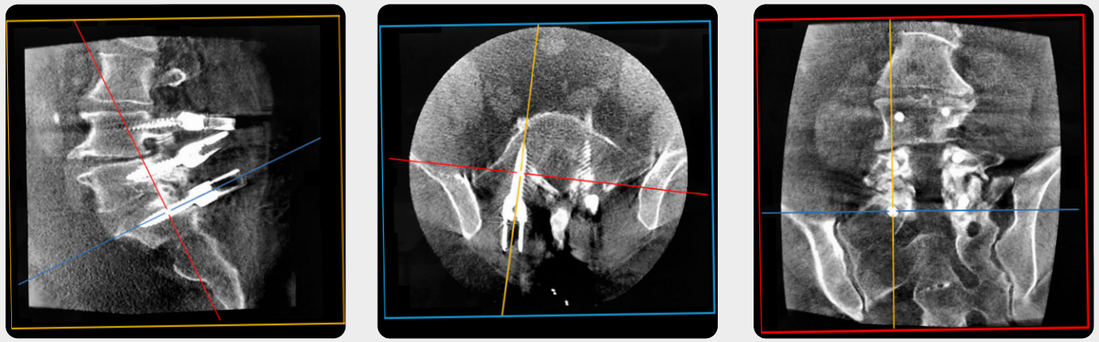
“With OEC 3D you can see all the vertebras at the same time, it’s fantastic! It has a wider field of view and more visualization power.”

Dr. Dan Christensson

“The Image Quality of 2D and 3D images is very good even on obese patients. It is important because people are getting more and more obese and we have to deal with more soft tissues, which bleed more and it’s becoming more complex to see.”

Dr. John Pak

Oblique views of L5 left pedicle screw



Conclusion

The clinical benefit of 2D and 3D imaging with OEC 3D C-arm delivering precise images in a 19 cm x 19 cm x 19 cm volume led the team to select OEC 3D C-arm for their daily practice.

“OEC 3D is full of options and has capacity above our needs.”

Dr. John Pak



The statements by GE’s customers described here are based on their own opinions and on results that were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results. JB05583XE

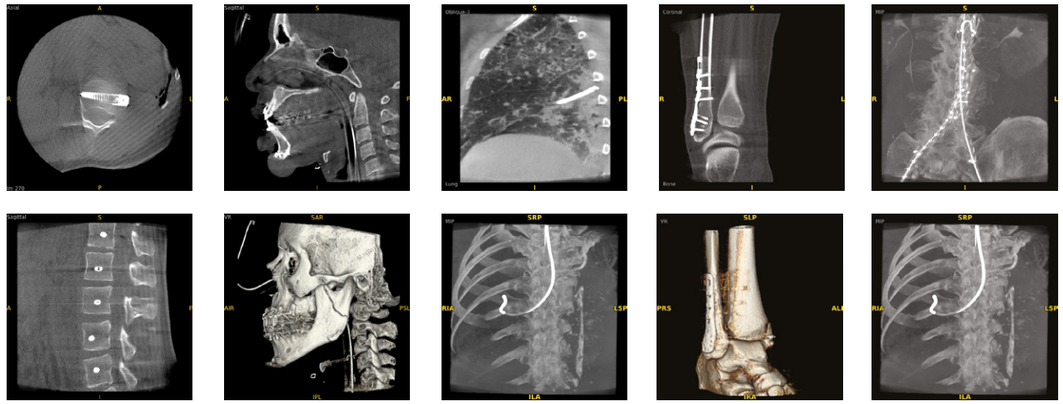
OEC 3D

Imaging capabilities every procedure room deserves

Streamline patient imaging with the versatility of a single mobile C-arm. With cone beam CT and fluoroscopy capabilities, OEC 3D delivers precise 3D and 2D images efficiently to every procedure.

Everyday utilization in one efficient mobile C-arm – the OEC 3D

Spine • Orthopedic • Trauma • Pulmonary • Maxillofacial • Interventional Radiology



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Spine surgery

A new standard in Spine Surgery

OEC 3D paired with neuronavigation

Interview with Dr. Rémi Gauthé and Dr. Vianney Gilard, spine surgeons, Centre Normandie Rachis, Clinique Saint-Hilaire, Rouen, France.

Clinique Saint-Hilaire is a medical and surgical institution in which the technical facilities are managed by multidisciplinary teams structured into three key divisions: medical and surgical division, cardiovascular division and cancer division.

In 2021, the medical and surgical division was strengthened by the incorporation of the Centre Normandie Rachis spine surgery practice. This practice comprises five surgeons who provide comprehensive management of spinal disorders affecting adults and children.

As part of the incorporation of Centre Normandie Rachis, an operating room was created to include a 3D imaging C-arm paired with neuronavigation. After testing different equipment, the center opted for the OEC 3D C-arm with integrated Brainlab Kick® navigation (Brainlab, Munich - Germany). Here, Drs. Gauthé and Gilard share their experience with 3D imaging and integrated neuronavigation after one year of use.





Dr. Rémi Gauthé is an orthopedic and trauma surgeon who specializes in spine surgery. After obtaining his medical degree from Université Paris-Descartes, he completed his clinical training in orthopedic surgery and traumatology at Rouen University Hospital–Charles Nicolle.

After working for four years as a resident, then for a year and a half as a hospital practitioner at Rouen University Hospital, he joined Centre Normandie Rachis at Clinique Saint-Hilaire in November 2021. Dr. Gauthé is a member of SOFCOT (Société Française de Chirurgie Orthopédique et de Traumatologie – French Society for Orthopedic Surgery & Traumatology) and SFCR (Société Française de Chirurgie Rachidienne – French Society for Spine Surgery). He is also a member of the French College of Orthopedic Surgeons, which manages the training of interns. Dr. Gauthé belongs to the Spine Research Community (SRC), which brings together 35 private physicians working together on a collaborative medical and clinical research project on the benefits associated with spine surgery.

Could you describe how Centre Normandie Rachis is set up at Clinique Saint-Hilaire?

Dr. Gilard: *Clinique Saint-Hilaire is a private family-run clinic owned by the Martin family. It is an independent institution committed to quality of care and quality of work life. This is clearly seen in the clinic's management, operations and focus on people. The clinic's moderate size enables it to operate more efficiently. Staff members know each other and work together as a team. The clinic has about 100 practitioners. There are 220 beds, half of which are dedicated to surgery. In addition, there is an oncology department, intensive care unit, post-acute care unit, cardiac rehabilitation unit and an outpatient unit. The clinic therefore provides a large proportion of regional care in medicine and surgery.*

Centre Normandie Rachis is a nominal partnership that brings together five spine surgeons from a variety of backgrounds and that delivers comprehensive care for all spinal disorders affecting adults and children. Our group includes one pediatric orthopedic surgeon, two adult orthopedic surgeons who specialize in spine surgery and two neurosurgeons.

I want to stress that we are particularly well equipped and set up at the clinic. Since my arrival, I have been able to use OEC 3D C-arm, an operating microscope, a Cavitron® aspirator, which is used to resect tumors in neurosurgical procedures, and other modern equipment. We are equipped in much the same way as a teaching hospital, which benefits both the staff and patients.

Dr. Gauthé: *Since I arrived at the clinic in November 2021, with my colleagues we have been developing the surgical management of spinal disorders in adults and musculoskeletal conditions in children and adolescents. We created a practice that previously did not exist. The clinic's management made the decision to build a modern operating room dedicated to spine surgery. As a result, the clinic now has equipment specifically intended for use in this facility, such as imaging and navigation systems and the operating table. We submitted a list of the equipment required for our practice, and the clinic then issued a call for tenders, after which we carried out tests and selected our equipment. It is in this context that we chose OEC 3D for the 2D and 3D imaging necessary for our procedures.*

We continue to work on building our facility in terms of operating room equipment, as well as the development of our patient consultation, namely communication with referring physicians who send us treatments. I have also started to take on a number of responsibilities regarding radiation safety and the operating room. The practitioners are involved in different areas at the clinic, such as quality, the users' committee, the infection committee and accreditation.

Within your practice, what are your requirements in terms of 2D and 3D imaging?

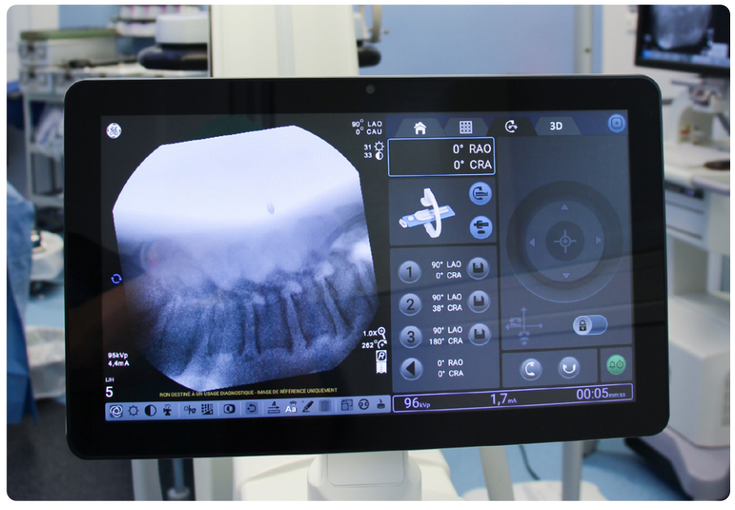
Dr. Gauthé: *Generally, all our procedures require either 2D or 3D imaging in the operating room. We perform very few surgical procedures without 2D fluoroscopic imaging because we routinely check the spinal level at which we are operating. Navigation and 3D imaging are not required for all procedures. Our practice is growing and is in its startup phase. We currently treat around four to five patients per day, over four days a week.*

Most of the procedures involve lumbar spine fusions and lumbar and cervical disc herniations, which account for about a third of the total volume.

With regard to the use of imaging, 3D guidance is routinely used in procedures involving the insertion of lumbar implants. This means that we do not always use navigation, but we do use volumetric imaging to check the placement of implants.

We use navigation alongside 3D acquisition for lumbar spine surgery when we anticipate difficulties: for example, when we know that there is extensive scoliosis, short pedicles or anatomy that is significantly altered due to extensive osteoarthritis. Therefore, when we expect difficulty from the outset in inserting the screws, we use the navigation system. Navigation is not routinely used. In cervical spine surgery, we never use navigation; instead, we use 2D imaging control in antero posterior and lateral views. Exceptionally, we may use 3D imaging. In this case, it is very easy with OEC 3D to switch from 2D imaging to 3D imaging. That is why the C-arm remains permanently available for use in our operating room.

> *"I think that 2D/3D imaging will become widely used even if only for 3D guidance."*
>
> Dr. Vianney Gilard



2D fluroroscopic image of lumbar spine in lateral view to check the spinal level.



Dr. Gilard and Dr. Gauthé preparing OEC 3D for the 3D acquisition.

Lastly, pedicle screw implantation represents the majority of our activity. This is a procedure in which 3D imaging guidance is the only way of ensuring that the implants are positioned correctly, that the screw is not in contact with a nerve and that it is definitely in the right place. This is what we look at when we perform an intraoperative 3D imaging with OEC 3D.

In the future, I think that imaging will always be necessary, if only to check the spinal level.

Dr. Gilard: *Intraoperative 3D imaging has become our new standard. Today, it is unimaginable to insert an implant without 3D guidance, especially when we are fortunate enough to have the OEC 3D C-arm at our disposal. Practically speaking, 2D imaging has its limitations, even from a purely medical perspective. This means that if a patient is relatively heavyset, you might not be able to see some implants using 2D imaging. There are also some anatomical areas that cannot be accessed with 2D imaging. However, 3D volumetric imaging provides a comprehensive solution to this problem, making it possible to analyze multiplanar views of large-volume reconstructions and enabling us to view the anatomy behind implants. This is also useful when treating nerve root compression, i.e., removing bone or osteoarthritis that is compressing a nerve root. This is not the most common occurrence, but we can check the quality of our decompression: we view the section of bone we made using forceps, and we can make an estimate to determine whether it is sufficiently clear of the nerves. We learned how to assess nerve compression using a preoperative scan and can now do this using volumetric imaging obtained intraoperatively with OEC 3D.*

Another issue to consider is radiation safety. With 2D imaging, lead aprons provide protection, but most of the time, we remain in the room during the imaging process, albeit at a distance. By contrast, 3D imaging with OEC 3D coupled with navigation makes it possible to produce a series of volumetric images with relatively low irradiation, while we remain out of the room. The rest of the procedure then involves little or no radiation, which offers long-term radiation safety to us and other staff members.

In parallel with this, there is a place for navigation, and there will always be a need for direct view imaging, especially endoscopic spine surgery, which is becoming more common. Today endoscopic spine surgery requires 2D imaging to triangulate the position of the endoscope in the treatment of disc herniation. In the future, endoscopy might be navigated with 3D imaging.

Can you explain to us the benefits of OEC 3D integration with Brainlab navigation for your procedures?

Dr. Gauthé: *In our surgical technique we use the bare minimum of navigated tools, i.e we work primarily with the navigated locator stylet. We position the screws according to the free-hand technique, then we check their position using OEC 3D intraoperative volumetric imaging.*

As with all other screw placement techniques, we work by touch and by controlling the force that we place on the instrument. For me, it is important to control the manual sensation applied to the instruments, to be able to adapt to the feel of the technique instead of relying on automated instruments.

Therefore, we prefer to use the navigation system to identify an entry point and establish the direction of the screws, then to check our technique using OEC 3D imaging.

Navigation is an undeniable aid, especially in the case of complicated screw implantation procedures. Navigation ensures a more precise and safer technique, making it possible to insert screws on the first attempt when the anatomical points of reference are accurate.

Generally, we use navigation if the preoperative imaging suggests that implantation may be difficult, for example, when there are vertebrae that are slightly twisted, short pedicles or significant alteration of the surface where a lot of bone has formed and the



Dr. Vianney Gilard is a neurosurgeon. Originally from Normandy, he studied medicine and completed his clinical training in neurosurgery at Rouen University Hospital–Charles Nicolle. During his clinical training, he specialized in pediatric neurosurgery and spine surgery and completed two placements: one at Necker–Enfants Malades University Hospital in Paris and the other during his postdoctoral fellowship at Great Ormond Street Hospital for Children NHS Foundation Trust in London. He spent three years working as a resident at Rouen University Hospital in spine surgery and general cranial and pediatric neurosurgery. He then worked as a lecturer and hospital practitioner at Rouen University Hospital for two years. Dr. Gilard joined Clinique Saint-Hilaire in September 2022.
Dr. Gilard is a member of the SFCR, SFNC (Société Française de Neurochirurgie – French Society of Neurosurgery) and the Spine Research Committee (SRC), through which he carries out fundamental and clinical research projects with his associates. Currently, he is focusing on spinal treatments in adult patients and retains an associate position at Rouen University Hospital in pediatric neurosurgery.



Dr. Rémi Gauthé reviewing the final control images of the procedure on the OEC 3D workstation using the 3D volume viewer.

“A decisive factor in the selection of OEC 3D was the volumetric image reconstruction method. I like having the ability to easily take oblique slice images in the screw axis, the vertebral axis, exactly as I used to do with a CT scanner in multiplanar reconstruction (MPR) mode.”

Dr. Vianney Gilard

anatomical landmarks are hard to identify.

Dr. Gilard: *Navigation should be viewed as an aid to identify anatomical landmarks and to facilitate our practices, rather than as a replacement for them. By inserting the screw in a single step, without damaging any anatomical structures, we maintain the stability of the implant. This ensures efficiency and patient safety.*

Furthermore, we considered radiation safety thoroughly since our specialty involves a high level of exposure. Our patients undergo surgery once, perhaps twice, in their lifetimes and are exposed to some X-rays. For us, we see as many as ten patients per week over a 35-year career. There is a real need to reduce our exposure to X-rays. When we use a navigation system, the staff and surgeons leave the room during the 3D acquisition, thereby significantly reducing their exposure.

For some procedures lasting up to three hours, this prevents us having to wear lead aprons, which has significant practical benefit. When we use navigation in the procedure, we take front and lateral views, we leave the room during 3D acquisition and we do not have to wear a lead apron during the procedure.

Dr. Gauthé: *The integration of the Brainlab navigation system with the OEC 3D C-arm is an additional benefit. The communication between the camera and the C-arm makes it possible to signal and suspend the trackers if the navigation trackers are not correctly located by the camera. If the navigation system were not integrated with the C-arm, we might proceed to the acquisition, realizing once the acquisition was complete that the navigation trackers were not in view of the camera, meaning that we would have to perform the 3D acquisition again. The communication between the navigation system and the imaging system is a kind of safety measure ensuring that we don’t perform a 3D acquisition that cannot be navigated. The integration allows the automatic transfer of the 3D images to the navigation computer. The calibration between the C-arm and the navigation system enables to avoid using an additional tracker on the patient in the 3D volume image. This simplifies the centering of the anatomy of interest in the 3D volume image and enables surgery to be performed with a clearer surgical field.*

After using OEC 3D for about one year, which features do you like and use the most?

Dr. Gilard: *I find OEC 3D quite user-friendly and intuitive. The OEC Touch control panel menus are simple, and it is easy to select/unselect the various fluoroscopy modes in 2D imaging.*

If the patient is thinner, I activate the low dose mode; otherwise, I usually work in standard mode. I only use pulsed mode, which is slightly more irradiating than low dose mode, with larger patients who are more radiopaque. I regularly use the collimation feature, which enables to reduce the radiation field to the anatomy of interest and improves image quality.

The 3D acquisition menu can be accessed at the same menu level as that of 2D imaging. It is easy to switch between 2D acquisition and 3D acquisition. This is simple to do because you can follow the different steps guided by the OEC 3D Setup Assistant.

In addition, the Volume Viewer on the Workstation is easy to use; it is intuitive and touch operated.

Dr. Gauthé: *In my practice, for 2D imaging, I usually set the C-arm to low dose mode and pulsed mode at 8 pulses per second. I deactivate low dose mode to see better if the patient is larger. But that is quite rare. I use the preset imaging profiles ‘Spine’ or ‘C-Spine’ depending on the procedure. For a cervical spine procedure, I configure the C-arm using the ‘C-Spine’ imaging profile and I am satisfied with that. For a thoracolumbar spine procedure, I configure the C-arm using the ‘Spine’ imaging profile. I find the image quality perfectly appropriate for carrying out my procedures.*

I like the anticollision system located on the detector. It is extremely effective. When performing a simple procedure with 2D imaging, the C-arm is placed under sterile drapes. If the C-arm touches the patient during its rotation, we are not aware of it. The C-arm signals this, and then it stops. We could describe this as a soft stop. Even if it touches the patient’s arm, it will not roll over it. It stops before that point. It does take up space, but that proves useful, too.

For 3D imaging, there are three acquisition modes: Standard (SD) mode, High Definition (HD) mode and HD+ mode. I usually configure the C-arm using the HD mode. When the system was installed, we activated the metal artifact reduction (MAR) feature, as well as the noise filter. Recently we have activated the eNR. We do not change these settings because we routinely work with metal implants and these filters enable us to obtain our desired level of image quality.

With the other 3D C-arms that we tested, reading the images was much too complicated.

Dr. Gilard: *In the past, I often used a different 3D C-arm, which was very bulky and lacked versatility.*

In our practice, we need a versatile 2D and 3D imaging tool. We also wanted the freedom to choose the navigation tool that we coupled it with.

As part of our selection process, we also considered the human support aspect. We did not choose a tool and an imaging system, we chose a team with whom we felt supported and assisted. We could have the best tool on earth, but if there were no customer service, engineers or a good working relationship, it would fail. We think that it works well and that’s why we’re happy to be here with you.

Dr. Vianney Gilard is a paid consultant for GE HealthCare and was compensated for his participation in this testimonial.
The statements by GE HealthCare customers described here are based on their own opinions and on results that were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist, i.e. hospital size, case mix, etc., there can be no guarantee that other customers will achieve the same results. JB25770XX

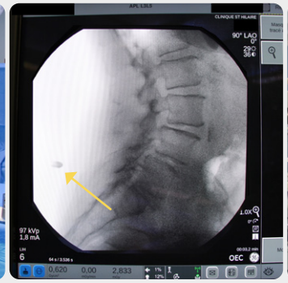
OEC 3D workflow if using navigation

Brainlab Drapelink navigation tracker for OEC 3D is fixed on the detector, and Brainlab system is connected to OEC 3D via the integrated navigation port of OEC 3D workstation. A single 2D image is acquired in lateral view over the patient lower back anatomy to identify the incision level necessary to fix the patient pin tracker on the ilium bone. This image is done with the spine imaging profile and standard continuous fluoroscopy. Once the incision is performed, surgeon prepares the navigation patient's tracker. After draping the equipement, surgeon proceeds to 3D imaging data acquisition.

Brainlab navigation preparation: Patient Tracker



Drapelink for OEC 3D fixed on detector handle.



Incision level on 2D spine profile.

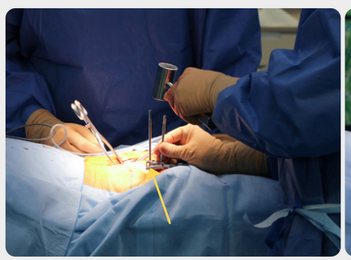


Patient incision for patient tracker placement.

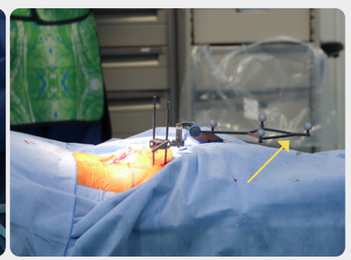




Preparation of patient tracker with its reflective marker spheres.



Fixation of patient tracker pin on the iliac crest.



Attachment of the reference array on patient pin tracker.

OEC 3D preparation: draping



Detector head draping



Patient draping with patient tracker visible



Brainlab camera is positioned in order to view both OEC 3D navigation tracker and patient tracker

OEC 3D - 3D Setup Assistant

STEP 1: 3D set up



Set up of patient orientation, imaging acquisition mode, dose level and 3D volumetric images reconstruction option.
Activation of the connectivity with the integrated Brainlab navigation system.

STEP 2: centering



Anatomy centering in the 3D volume – AP and Lateral view.

OEC 3D - 3D Setup Assistant

STEP 3: collision check



Collision check over 200° rotation starting point at + 130°. All over the 200° rotation, OEC 3D and Brainlab navigation system communicate checking the trackers are visible. During the 3D collision check doctor verifies that the Brainlab navigation systems sees the navigation trackers.



Collision check complete.

OEC 3D - 3D Setup Assistant

STEP 4: imaging





Brainlab camera tracks the C-arm position and the patient position for each image of projection acquired.
OEC 3D displays projection images acquired at each degree.
OEC 3D completes acquisition of projection images for volumetric image reconstruction up to 200° rotation.



OEC 3D rotation and exposure stops automatically when the percentage of completion shows 100%.



3D volumetric images are automatically reconstructed, displayed on OEC 3D workstation, and sent to Brainlab navigation system.
Doctor is ready to start navigated surgery.

Lumbar spine fusion



Surgeon working with pointer to identify entry point and direction of the screws to be placed in pedicle.



Pedicle screws are placed with free-hand technique.



GE HealthCare

OEC C-arms

Efficient imaging for more procedures

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OEC 3D: Featuring CBCT imaging



OEC Elite CFD



OEC One CFD



Spine surgery

Routine CBCT imaging in spine surgery

With OEC 3D

Interview with Dr. Peter Försth, M.D., Ph.D. spine surgeon and hospital manager of Aleris Elisabeth hospital, Uppsala, Sweden.

Aleris Elisabeth hospital is part of the healthcare network in the renowned university city of Uppsala, in East Central Sweden. The Aleris Elisabeth private hospital works alongside the many biotech and healthcare companies in the area, specializing in orthopedic care and in minimally invasive spine surgery (MISS) in particular.

The Elisabeth hospital premises were built in 1911 as a home for widows, by Elisabeth von Bahr, a Swedish philanthropist. The building was transformed in 1989 and became the Elisabeth hospital run by Aleris healthcare company since 2005.

Many orthopedic surgeons and neurosurgeons from Uppsala university hospital seeking expertise and a modern infrastructure to perform spine surgery, come to Aleris Elisabeth hospital to operate on their patients.

Faced with the growing demand for MISS and the challenge of equipping the small operating room of the impressive historical building, and after a trial process of surgical C-arms, Aleris Elisabeth hospital selected OEC 3D for its ease-of-use in routine practice as well as its image quality in 2D and 3D imaging.

Dr. Peter Försth, M.D., Ph.D. manager of Aleris Elisabeth hospital and spine surgeon told us why he chose OEC 3D for spine surgery.



Dr. Försth, can you describe the activity of your hospital?

'Aleris Elisabeth hospital is a private general orthopedic hospital treating musculoskeletal disorders of the shoulder, hand, hip, knee and spine. Spine surgery represents about one-third of the total volume of our surgical procedures.

In this hospital, we also have the mission to train university medical students in our areas of expertise. I myself teach young specialists in spine surgery and I'm engaged organizing classes for spine surgeons of the Swedish Society of Spine Surgery. Some of these surgeons working at Uppsala university hospital bring their patients in our hospital to perform the surgery with our facility and staff. About 80% of the spine surgeries done in Aleris Elisabeth hospital are performed by surgeons from Uppsala university hospital.

Beside my clinical work, as the manager of Aleris Elisabeth hospital, I am also in charge of organizing the entire orthopedic surgery activity. The orthopedic hospital accommodates 16 beds. We treat patients coming from the region of Uppsala, and also from other regions in Sweden. Surgery is performed in three operating rooms (OR) with three C-arms. The OR staff is trained to perform all types of orthopedic surgical procedures and rotates in the three ORs. One anesthesiologist supervises the anesthesiology nurses. As we have spine surgery almost every day, we dedicated OEC 3D to the spine surgeons who are assisted by at least one scrub nurse, one anesthesiology nurse, and one circulating nurse.'



How does OEC 3D contribute to supporting your surgical activity?

'The OEC 3D C-arm that we acquired one year ago is mainly being used for spine surgery. The staff assists surgeons in operating the OEC 3D C-arm during the surgery. Surgeons use the workstation menu of OEC 3D to review the 3D images.

> *"One real advantage of OEC 3D is that it is a pretty user-friendly 3D C-arm."*
>
> Dr. Peter Försth

The instructions on the screen for the user operating the C-arm are very clear.

During my career, I have worked with other mobile 3D imaging and navigation systems that were more complicated to use. With OEC 3D, we already know that the imaging part is quite easy.

Indeed, we use 2D imaging for all our procedures and we use 3D imaging for lumbar fusion procedures, which represent approximatively 80 to 90 procedures per year.

After lumbar fusion, the most common procedure is lumbar decompressions followed by lumbar disk herniations that we treat with a minimally invasive approach using 2D imaging. We also perform anterior cervical discectomy and fusion (ACDF) and posterior cervical surgery with 2D and 3D imaging.

We are developing our treatment offering for MISS through the use of endoscopic surgical techniques. Endoscopic spine surgery is a hot topic. This is a very interesting surgical technique for which we need 2D imaging to place the endoscope and its tools correctly in the patient.

> *"With OEC 3D we obtain a good image quality: it's quite easy to find the anatomical structures you need when you do endoscopic surgery. "*
>
> Dr. Peter Försth

As I mentioned earlier, we always perform a 3D scan as a postoperative check before closing the wound in lumbar fusions. Some of our orthopedic surgeons are also interested in performing a 3D scan during osteotomies of the knee. Currently, orthopedic surgeons have used OEC 3D, but only for 2D imaging, and have found it to be very useful due to its large field of view. They are considering doing 3D scans however they don't have access to OEC 3D that we are using almost every day for spine surgery.

The space in our OR is quite small, so the 3D C-arm couldn't be a bulky system. We selected OEC 3D after testing different C-arms because it's a user-friendly and compact C-arm.

When testing for the selection, it was also important for us to get a feeling of how OEC 3D would fit into our daily practice. We trusted GE HealthCare's ability to provide us with application and service logistical support. This was another criterion that played a role in our selection. OEC 3D represents a significant investment for our hospital.

As a surgeon and the manager of the hospital, the most important thing for me is patient safety: before we close the wound, when we have finished with our surgery, we want to be able to verify that the implants are in the proper position. With OEC 3D in the OR, we do a final CBCT of the implants and get an assessment directly.

By investing in perioperative 3D imaging, surgeons can revise implant's malplacements if needed before finishing the surgery. We are assured of providing a better patient care experience and we reduce the risk of revision surgeries and their associated costs and discomfort for the patient..

Of course, it is also an economic benefit for the hospital to eliminate the need of postoperative CT exam. This is particularly true of our hospital given that we don't have the capacity to do CT imaging in our facility and had to send our patients to the university hospital. It's quite demanding and delays the assessment of the screw placement after the surgery. It is not a very good quality of care.

Before working with OEC 3D, we used radiographical images for postoperative control, but this procedure is not accurate to estimate the screw placement in the body. We don't do it anymore. It saves time and cost, but as I told you, the most important win is patient safety.



> *"The perioperative CBCT images from OEC 3D are of a much higher quality than the postoperative imaging diagnostic with which we were working."*
>
> Dr. Peter Försth

What OEC 3D features do you use most for 2D imaging?

'The OEC 3D C-arm gives an excellent image quality in 2D imaging. Working with a motorized C-arm was a new experience for us, and initially, we thought it would be difficult. That is not the case at all. Surgeons, who had to move the C-arm themselves as they wished, can rely on the staff to operate the equipment. The joystick is easy to handle and is used when the surgeon needs small changes in the angles. The staff also learned how to move the C-arm from AP views to lateral views, or for other larger angles, by setting and using the preset memory buttons. It is therefore easy to access the body part that we want to image.

Another important benefit of OEC 3D is that the image covers a larger part of the spine. With our previous C-arm, the anatomical coverage was smaller.

We configured OEC 3D with our application referent, so that it automatically starts with the preferred parameters: spine imaging profile, standard fluoroscopy, and low dose mode. For very obese patients as well, I feel that we don't have to adjust anything. OEC 3D also gives us good imaging for these patients.

We also use the Live Zoom especially when inserting pedicle screws and we want to magnify certain parts of the anatomy.'

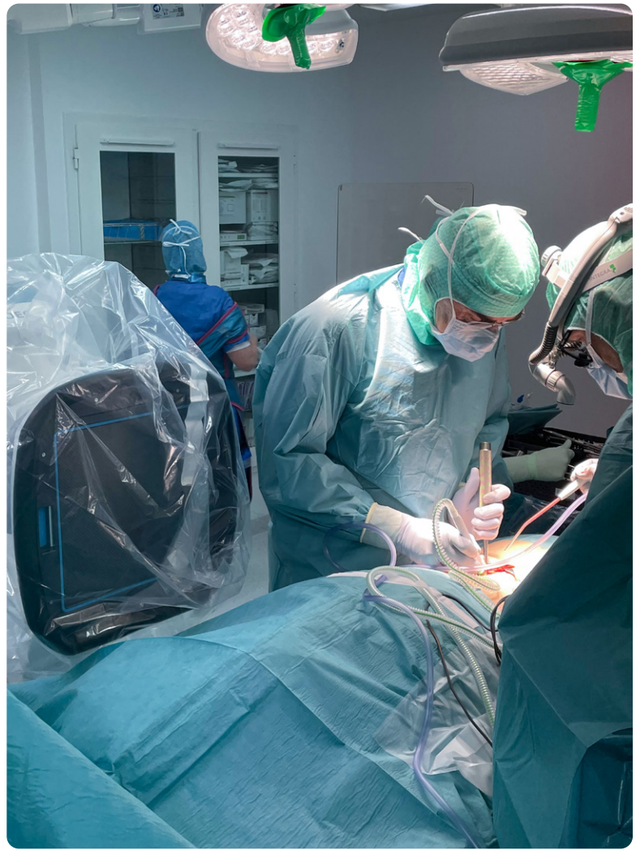
How do you set up OEC 3D to perform the 3D scans?

'For the 3D scan, we set the Standard mode or High Definition mode. We also use the metal artifact reduction (MAR) filter to verify the position of the implants in the volumetric images.

> *"With this OEC 3D configuration, we don't have metal artifacts, and we see what we need to see i.e."*
>
> Dr. Peter Försth







With this OEC 3D configuration, we don't have metal artifacts, and we see what we need to see i.e., we see the cortical bone of the vertebra, and we see the metal in the screws. We also clearly see the borders of the vertebra.

I review the volumetric images on the OEC 3D workstation myself. I look at the sagittal and also the axial views in general. I don't use volume rendering (VR) as much. VR is a very nice illustration of what we have done, but clinically it is not completely relevant to verify the screws placement.

The size of the 3D volume that we get with OEC 3D is quite enough for the type of fusion surgeries we perform.

We don't operate on large deformities, so the anatomy we see today in the 3D volume is more than sufficient and of very good quality.

When doing the 3D scan, everyone stays inside the room. Of course, we move away from the C-arm and the sterile staff goes behind a leaded screen. As we all wear a lead apron, we just need to move away from the C-arm to protect ourselves from X-ray radiation. Over time, we have learned to better set up the patient and the table accessories for the 3D scan.

It was quite easy for the staff to learn how to use OEC 3D. We receive no protests during application training! The staff also see the benefits for the patient when they look at the 3D images and can assess whether the implants are correctly placed.

We have good feedback on OEC 3D from all the operating room staff.'





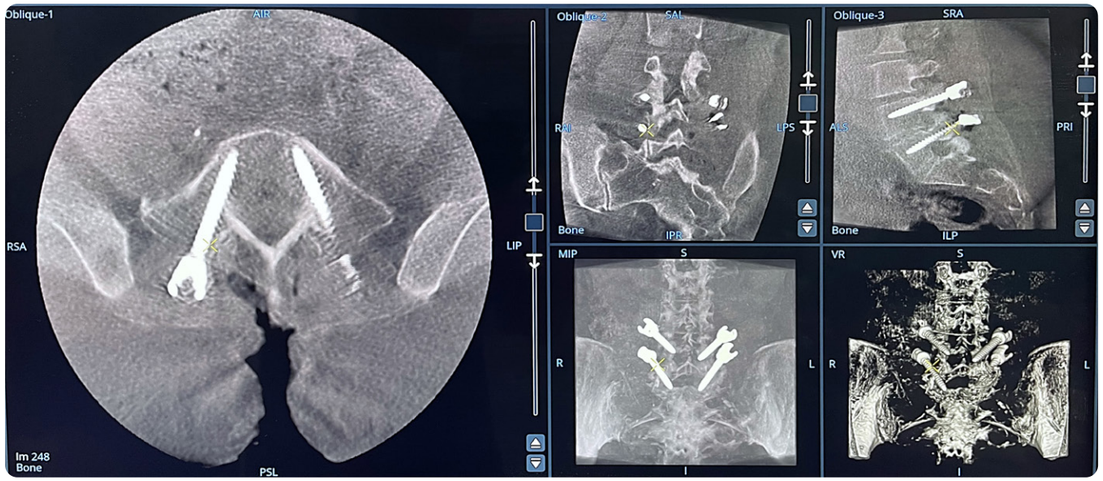
How do you foresee your activity evolving with OEC 3D?

'With OEC 3D, we plan to develop endoscopic spine surgery as well as intraoperative spine navigation to manage X-ray radiation even more during some spine surgery procedures.

The Swedish healthcare system is an evidence-based medicine and recommends continuing the placement of pedicle screws without robotic support. We plan to continue working with the free-hand technique and with perioperative 3D imaging.

We are also working to have all the images entered in the university hospital PACS system so that we can share all our images from OEC 3D.'

> *"OEC 3D really brings clear benefit for the patient in terms of patient safety, but also for the surgeon as you can be sure of your surgery before you close the wound."*
>
> Dr. Peter Försth





Dr. Peter Försth, M.D., Ph.D. is an orthopedic surgeon specialized in spine surgery that he has been practicing for 22 years. He holds a Ph. D degree in surgery for lumbar spinal stenosis (LSS). He practiced spine surgery at Uppsala university hospital as a spine surgeon then as the head of the spine surgery unit.

Since 2022, Dr. Försth is the manager of Aleris Elisabeth hospital in Uppsala where the spine surgery department focuses on the treatment of degenerative spine diseases from the cervical to the lumbar region. He is chairman of the Swedish Society for Spine Surgeons for which he trains young surgeons. Dr. Försth is also faculty member of the education program of EUROSPINE, for the module covering the degenerative diseases of the spine. This diploma is recognized at the European level by many spinal societies and federations. In addition to his interest in educating the future generations of spine surgeons, Dr. Försth also focuses on the development of minimally invasive spine surgery techniques including endoscopic navigated techniques.

The statements by GE's customers described here are based on their own opinions and on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results. JB07569XE

Maxillofacial surgery

Intraoperative mobile cone beam CT scanner for maxillofacial surgery

Dr. Nils Petter Fossland, head of the department of maxillofacial surgery, and Dr. Mats Säll maxillofacial radiologist, at St. Olavs University Hospital, department of maxillofacial surgery, Trondheim, Norway.

The department of oral and maxillofacial surgery of St. Olavs University Hospital was established in 1962. It includes an outpatient clinic and six operating suites shared with the ear-nose-throat (ENT) department.

Expanding minimally invasive surgery for maxillofacial procedures in Norway for the past five years, Dr. Fossland, head of the department of oral and maxillofacial surgery and Dr. Säll, maxillofacial radiologist, decided to invest in a cone beam CT (CBCT) C-arm for their surgical suite. They selected OEC 3D which provides precise intraoperative CT-like volumetric images with the level of precision required for their complex maxillofacial procedures. The 3D intraoperative imaging with OEC 3D allows them to confirm a high-quality procedure before the patient's discharge from the operating room (OR). As a result, the team decided to eliminate postoperative CT-scans.

After one year of practice with this new patient care pathway, created using intraoperative OEC 3D CT-like images, Dr. Fossland and Dr. Säll tell us what benefits they have found for their routine activity.





In the ‘Operating Room of the Future’ maxillofacial surgical suite, OEC 3D stands next to the patient operating table. While fluoroscopic imaging is not used in maxillofacial surgery, Dr. Fossland and Dr. Säll selected the OEC 3D C-arm to be used primarily as a mobile intraoperative CBCT imaging system. They explain why this choice allows them to avoid the postoperative CT, and how the patient benefits from a review of the surgery in the OR before discharge.

Dr. Fossland, can you explain the activities and surgical procedures of your department?

‘The oral and maxillofacial department has 6 surgeons trained and specialized in oral and maxillofacial surgery working in two dedicated ORs. Personally, I am trained both in ENT and maxillofacial surgery. However, today in Norway most maxillofacial specialists are both medical doctors and dentists who completed their training in oral and maxillofacial surgery.

Our field of expertise covers: dentoalveolar surgery (cyst and tumor treatment), dental implants, trauma surgery of the facial skeleton, orthognathic surgery (correction of bite disorders and facial asymmetries), plastic and reconstructive surgery of head, neck, and face, and open surgery of the jaw joint.

As a university hospital we have developed our expertise in these areas and have become the reference center of the region Central Norway for facial injuries, reconstructive and orthognathic surgery. We work in collaboration with orthodontists from Central Norway region, but we also receive referrals from other parts of the country for an assessment regarding surgery.

We have developed quite strong expertise in major reconstructive surgery of the head, neck, and face after traumatic injuries and cancer surgery. We have a good collaboration with both the ENT and Plastic Surgery departments here at St. Olavs University Hospital, allowing us to provide the patient with the most comprehensive care pathway possible.

Whenever possible, we want to provide a minimally invasive surgery approach. We offer endoscopic treatment of salivary gland disorders such as the removal of stones or the relief of the obstructions in the strictures of salivary gland and ducts. This is a minimally invasive operation where we enter the normal opening of the salivary gland duct with small camera and its working channel. In addition, we propose arthroscopy to diagnose and treat disorders of the temporomandibular joint (temporomandibular disorders – TMD), where this is indicated.

Over the last twelve months, our team performed about 1,100 surgical procedures. A significant part of the major surgeries is performed with OEC 3D to access intraoperative image control in the OR. Of these, there are about 75 to 100 facial fracture reduction surgeries, 50 orthodontic surgeries, 50 orbital surgeries, as well as in a smaller volume reconstructive surgery of orbital tumors and reconstructions of the temporomandibular joint (TMJ) with TMJ prosthesis.’

Dr. Fossland, can you share an example of a complex procedure where OEC 3D provides clinical benefits?

‘In orbital surgery it is very helpful to have intraoperative CT-like images because we perform very small incisions, and even while using intraoperative navigation, it can be difficult to estimate the precision of the implant placement toward the apex of the orbit.

Since we can acquire and review volumetric images during the surgery, we no longer have to wait for the postoperative examination of the patient, which is based on pain felt when moving the eye after surgery and performing a postoperative CT scan to see if the implant is one millimeter too high or not exactly where we wanted to place it with the risk of touching an eye muscle. The patient will then need to go back to surgery. Revision surgery has a cost and takes up time and resources. Now that we can access 3D images during the procedure in the OR, with a precise image quality to check the orbital implant placement, we avoid complications of revision surgery.



Dr. Fossland reviewing intraoperative CBCT on the OEC 3D workstation display.

"I did several orbital surgery procedures with OEC 3D and I am very happy, OEC 3D is perfect for that."

We estimated that about 10% of the orbital reconstruction and orthognathic procedures required revision upon review of the postoperative CBCT scan. This is how we could justify the return on investment of purchasing OEC 3D to my administration, by reducing that number of revision surgeries, over a 10-year period.

'I believe we are quite an advanced maxillofacial department in Scandinavia. We have in our department our own preoperative CBCT scanner for diagnostics, which we acquired 6 years ago, replacing our old CBCT from 2010. We use 3D printers to create templates to plan the complex surgeries. And now we are the first maxillofacial department in Scandinavia routinely using an intraoperative mobile CBCT imaging system for a clinical application. I have heard of some colleagues in Sweden who have acquired other types of 3D C-arms, but they are not using it in their routine because it is too complicated, instead, preferring to limit its use to research in specific cases. This is why we choose OEC 3D from GE HealthCare. Our university department has a strong history of looking towards technology at the service of clinical needs.'

Dr. Säll, can you explain your role and what are the main drivers that led you to choose OEC 3D for the maxillofacial surgery OR?

'I started my career as an intensive-care nurse as which I worked for 17 years, after which I became a dentist, working as such for 7 years, and finally I specialized in maxillofacial radiology. I have been working as a maxillofacial radiologist for 8 years now. I interpret the images and write notes for the surgeons. This is how our hospital is organized: radiologists are medically trained and specialized in different clinical domains.

Our 'Operating Room of the Future' project is to equip a larger operating room that we share with ENT surgeons. We are building it to satisfy the needs of different types of surgery. With this in mind, about two years ago we started to investigate the performance of 3D C-arms. We entered in communications with the different manufacturers, and we tried their C-arms.

In maxillofacial surgery, we never use C-arms for 2D fluoroscopic imaging as orthopedic surgeons do. Rather we need 3D volumetric imaging. The use of a C-arm is new to our team. I've trained twelve nurses in the maxillofacial OR on OEC 3D at once, and they find it very easy to use. It is significant as none of these nurses had ever been using a C-arm before! Ease of use was an important criterion. OEC 3D workflow is highly suited to the 3D acquisition and 3D image review in the OR environment.

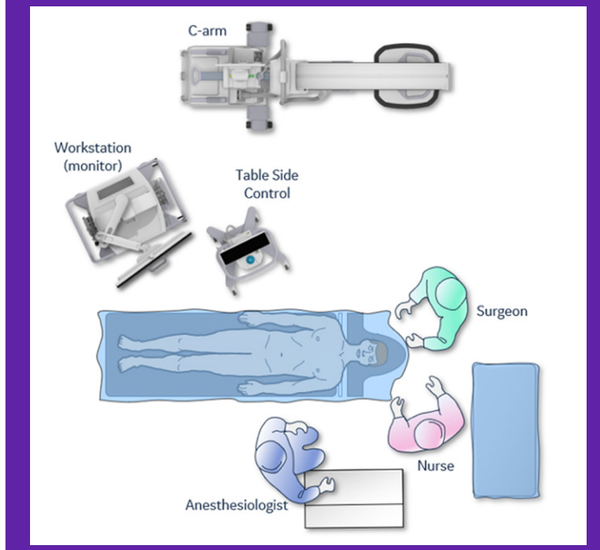
Personally, I love to review the multiplanar reconstruction (MPR) images using the oblique views. Then we send the 3D data to our PACS for further reviews. The last 3D acquisition of the procedure is used instead of the postoperative CT. This dataset is managed in our PACS along with the rest of the patient data records, as is the case for MRI or CT scan diagnostic data. The radiology department has a huge workload, so radiologists are in favor of us using this intraoperative imaging in the place of the postoperative scanner. And as I am the radiologist of the department, it is ok for the radiology department.

Of course, a main criterion in our selection was the image quality of the volumetric images since surgeons perform minimally invasive surgical techniques and work through very small incisions, using small screws and small plates. The 3D images of OEC 3D are very good.

"Indeed, in our activity, we use OEC 3D more as a mobile intraoperative scanner."

Sometimes we perform a 3D acquisition during the procedure, and we always perform a 3D scan at the end of the procedure to verify the position of the implants before discharging the patient.

OR Layout during Maxillofacial surgery



OR Layout during intraoperative CBCT control



'Operating Room of the Future' set up during surgery and during intraoperative CBCT imaging.

In order not to degrade the image quality of our intraoperative CT-like images obtained with OEC 3D, we are in the process of replacing all our patient tables with carbon-fiber tables over the next two years.'

Dr. Fossland, Dr. Säll what is your vision of the future for your operating room?

Dr. Säll: *'We are working on optimizing our 'Operating Room of the Future' to set up the Brainlab ENT navigation system for cochlear implant placement procedures. Today this activity represents about 20 procedures per year. We expect this volume to grow once we have completed the installation. The volumetric images acquired with OEC 3D bring a good indication of the exact positioning of the tip of the electrode inside the 3 chambers of the cochlea. It is more beneficial for the patient to complete this imaging in the OR while asleep, rather than using the postoperative CBCT scanner while sitting awake, resulting in motion artifacts on the image. Thus, using OEC 3D as a mobile intraoperative scanner for the quality control of the procedure provides more information than we can get using the postoperative CBCT.*

When we started the cochlear implant placement procedure with OEC 3D, I reviewed the images with another radiologist. He compared the volumetric images of the same bones of the internal ear obtained using OEC 3D with the ones obtained using the postoperative CT scanner. We concluded that OEC 3D provided images with outstanding image quality of this anatomy. As a result, there is a consensus in our team that we can start the cochlear implant placement activity with OEC 3D.

In ENT we are also interested in acquiring 3D images of the sinus to update the navigation volume intraoperatively. There are many ways to use OEC 3D in maxillofacial and ENT surgery for the benefit of the patient. We are just starting the journey!'

Dr. Fossland: *'From the clinical point of view, we are considering broadening the use of intraoperative volumetric images for the surgical treatment of sleep apnea. In this case it makes sense to verify the alignment of the jaw before discharging the patient. OEC 3D will also be used by the ENT surgeons to confirm the intracochlear placement of cochlear implants. We have a broad range of procedures that could benefit of intraoperative volumetric CT-like images that we need to investigate.*

"In our experience, the image quality of the intraoperative volumetric images of OEC 3D is better than the image quality we get with the postoperative CBCT."

During the postoperative CBCT acquisition, the patient stands up and the image is degraded by motion artifacts even if the acquisition duration is only 15 seconds. We have a better contrast adjustment on OEC 3D that gives a better view of the soft tissues. OEC 3D is used for final imaging, and then upon the review of the volumetric images, the surgeon can close and discharge the patient. We estimate that the patient dose with OEC 3D is one-sixth of that if the patient underwent a standard postoperative CT scan of the skull. This is a further advantage of performing intraoperative CBCT imaging with OEC 3D.

With OEC 3D, we can see some tumor contours, and in the future, it would be interesting to be able to differentiate soft tissues enough to perform measurements. For example, this would be very valuable for one of the most complex anatomies to analyze, namely the temporomandibular joint, made up of a complex structure of nerves, muscles, fibrocartilage, and a disk. A step forward in image quality would allow us to distinguish all these tissues during the operation. Today we can only access this information through a preoperative or postoperative MRI.

I really like the image resolution. I think it is better than on our postoperative CBCT that is already 5 years old. I am very impressed by how easy it is to run a 3D acquisition, the nurses do it by themselves. The nurses learned extremely fast how to perform the 3D acquisition. I just stand back and say 'do it'. Then I review the 3D volume images on the workstation by myself.' n



Dr. Nils Petter Fossland
After completing his internship in Kristiansund Sykehus in 2004, Dr. Fossland practiced as a consultant in ENT and head and neck surgeon in Aleris Norge hospital in Trondheim. He completed his curriculum through a observational fellowship in microvascular reconstruction Head and Neck Surgery at Chris O'Brian Lifehouse in Sidney, Australia.
Since 2015, Dr. Nils Petter Fossland practices as chief surgeon of the department for oral and maxillofacial surgery at St. Olavs University Hospital in Trondheim, Trøndelag, Norway with a double specialty in ENT and oral and maxillofacial surgery.

Reconstruction of a traumatic orbital floor with Titanium mesh implant

Courtesy of Dr. Nils Petter Fossland and Dr. Mats Säll, St Olavs University Hospital, Trondheim, Norway

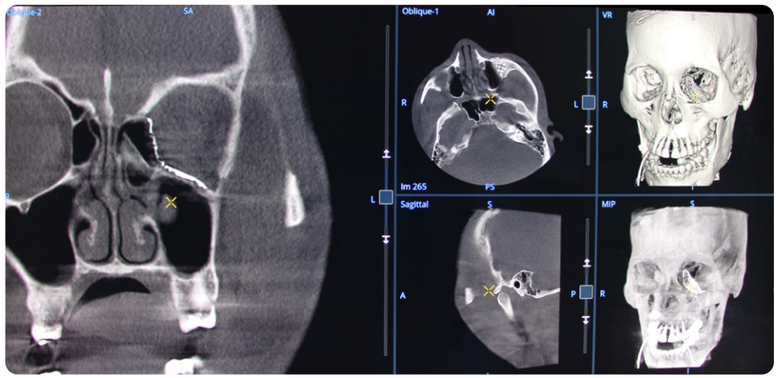
Minimally invasive surgical repair of the complex anatomy and physiology of the orbital globe is an elaborated procedure that requires a precise placement of mesh to the order of a millimeter.

Patient History

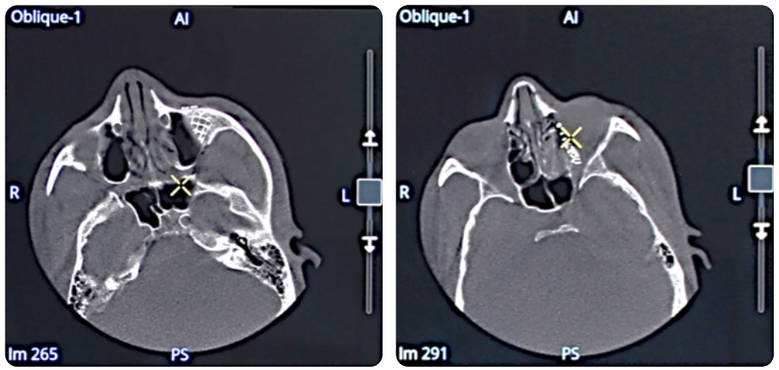
The patient presented a traumatic fracture of the left orbital floor and was eligible for minimally invasive surgical reconstruction of the orbital floor by the placement of a titanium mesh implant. The procedure was performed under general anesthesia. No fluoroscopic imaging was performed during the procedure. OEC 3D was used for 3D confirmation at the end of the procedure. The intraoperative CBCT imaging allows surgeons to review the implant placement before discharging the patient, reducing the risk of potential revision surgery, and removing the need for postoperative CT imaging.



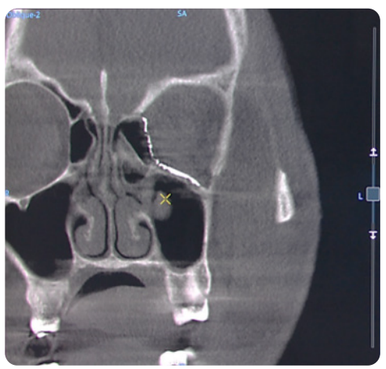
Dr. Mats Säll reviewing the final CBCT images of the procedure on the OEC 3D workstation using the 3D volume viewer.

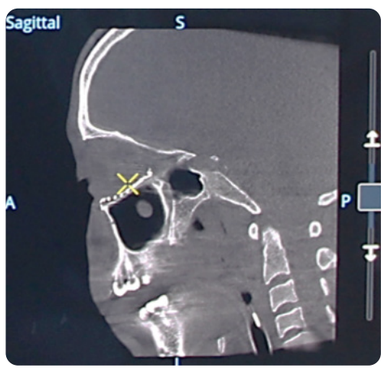


Orbital wall reconstruction with a mesh implant: volumetric images multi oblique views, Volume Rendering (VR) and Maximum Intensity Projection (MIP).



Volumetric images of the mesh in multi oblique view in axial direction.





Volumetric image of the mesh in multi oblique view in coronal and sagittal directions.



Volumetric image of the mesh in Volume Rendering format.

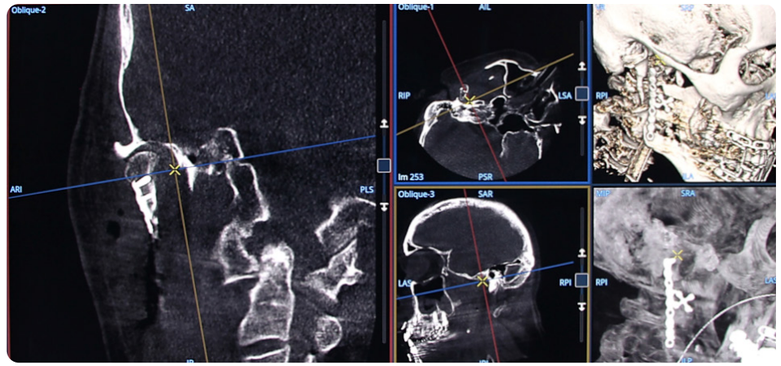
Right temporomandibular joint (TMJ) repair with alloplastic implant

Courtesy of Dr. Nils Petter Fossland and Dr. Mats Säll, St Olavs University Hospital, Trondheim, Norway

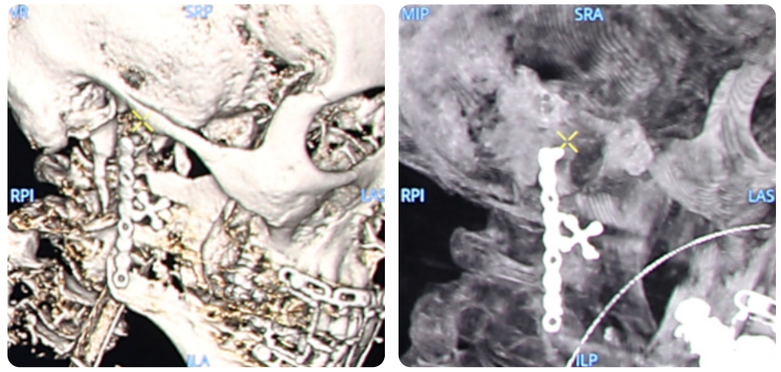
The temporomandibular joint is a complex anatomy formed by an assembly of nerves, muscles, fibrocartilage, and a disk.



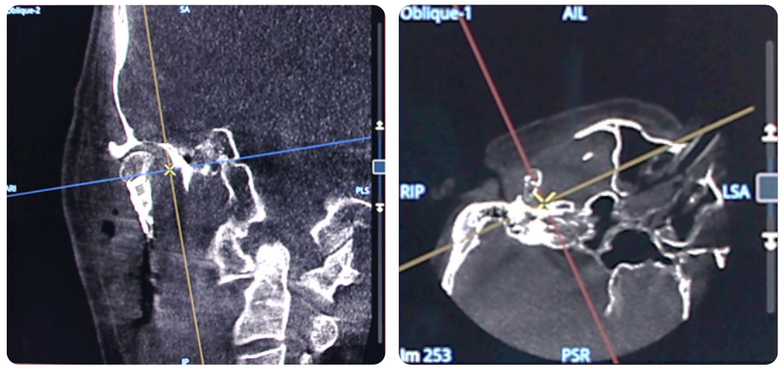
Dr. Mats Säll reviewing the final CBCT images of the procedure on the OEC 3D workstation using the 3D volume viewer.



TMJ reconstruction with alloplastic implant: volumetric images in multi oblique views, Volume Rendering (VR) and Maximum Intensity Projection (MIP).



VR (left) and MIP (right) images showing the type of implants.

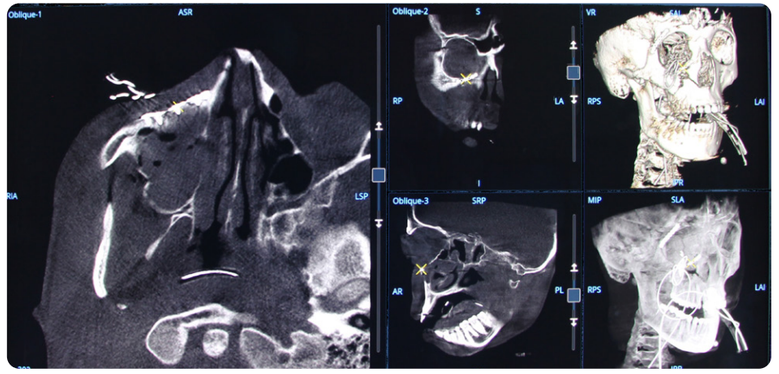


Volumetric image of the implants in the TMJ in multi oblique view in coronal and axial directions.

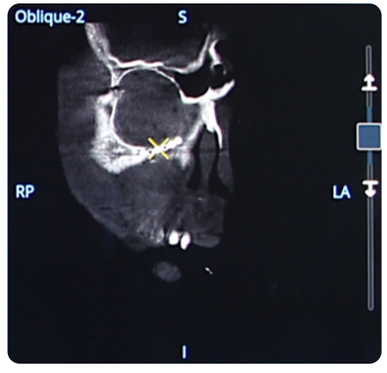
Right orbit fracture reduction with plate and screw fixation

Courtesy of Dr. Nils Petter Fossland and Dr. Mats Säll, St Olavs University Hospital, Trondheim, Norway

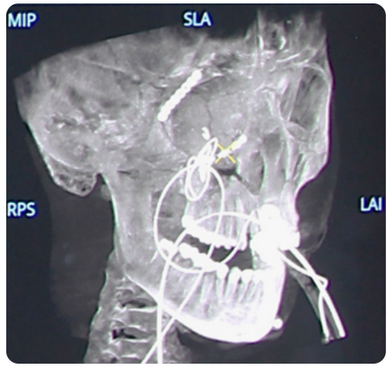
In this case, tiny plates and screws have been placed for the reconstruction of the orbit anatomy with minimally invasive access. Final intraoperative CBCT has been performed to verify implantation.



Orbit reconstruction with plates and screws: volumetric images in multi oblique views, Volume Rendering (VR) and Maximum Intensity Projection (MIP).



Volumetric image of the lower plate in multi oblique view in coronal direction.



MIP image showing the two plates in the upper and lower part of the right orbit.

The statements by GE's customers described here are based on their own opinions and on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist, i.e. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results. JB25193XX

Trauma surgery

Trauma Surgery: routine 2D / 3D imaging with OEC 3D, isocentric C-arm

Interview with Dr. med. Steffen Koenig, head of the clinic of trauma and reconstructive surgery, Märkisch-Oderland Hospital, Strausberg, Germany.

Located 30 km east of Berlin and 30 km west of the Polish border, Strausberg is the largest town in the district of Märkisch-Oderland. In 2000, in order to meet the population's demands for HealthCare, the Märkisch-Oderland Hospital merged the clinics in Strausberg and Wriezen, creating a modern hospital network.

Thus, in 2008, in addition to the clinic for orthopedic surgery, the hospital of Strausberg created the clinic of trauma and reconstructive surgery under the leadership of Dr. med. Koenig. Since, the clinic has continued to develop its expertise by focusing on the specialized care of patients victim of acute accidents.

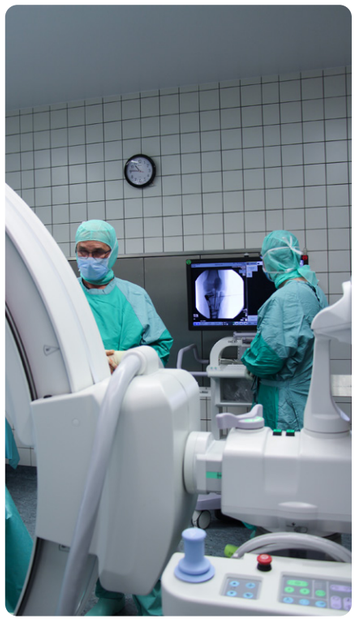
One specialty of the clinic being the treatment of spinal injuries in minimally invasive surgery techniques, the department recently acquired OEC 3D for intraoperative 3D imaging with high precision.

Dr. med. Koenig shares with us what was important for the selection of the new 3D C-arm and how his hospital integrated the OEC 3D C-arm for orthopedic traumatology procedures.





Dr. Koenig and Dr. Peuthert operating a patient knee.



Dr. Peuthert checking 2D image on OEC 3D workstation.



Dr. Koenig checking patient draping before running 3D acquisition.

Dr Koenig can you explain us the activity of the department of trauma and reconstructive surgery in Märkisch-Oderland Strausberg Hospital?

The district of Märkisch-Oderland counts approximately 200,000 inhabitants. Healthcare for this population is covered by a total of four hospitals. Three of these four hospitals are in our group: the hospitals of the cities of Wriezen, Seelow, and Strausberg.

The hospital of Strausberg covers various clinical activities including that of orthopedic surgery directed by one of my colleagues as well as that of traumatology and reconstructive surgery which I lead.

The primary spectrum of our activity is emergency surgery of age-related trauma due to the demographic evolution of our district. Thus, we treat a very large number of fractures of the upper leg proximal to the hip joints, as well as emergency surgery of big joints such knee and spine.

Our clinic is approved for the process of consultation of accident but not for treatment of severely injured patients. These patients are addressed to the emergency hospital in Berlin.

The staff includes our senior surgeon Dr. Peuthert, two specialists, three assistants and myself as head of the clinic. We can manage patients through the community health center. For example, the classic case is someone comes in with a broken wrist that we cannot operate straight away. We would manage this patient through the community health center and then ultimately perform surgical management when it's possible for us to do so. One of our operating theaters is actually an emergency room. It is currently managed by a senior physician, a deputy, and an assistant physician. The clinic has 30 beds and we also have beds that we can use in intensive care and intermediate care.

As a trauma specialist, what is your experience with surgical imaging and how did you choose OEC 3D?

I started working with 3D C-arms in 2004 when I was senior physician in emergency surgery in the Northwest hospital of Frankfurt am Main and later in the hospital of Lahr/Ettenheim. Back there I could gain experience and see the benefits in 3D imaging and also use navigation systems with the first generation of products we used from Siemens.

When I joined the hospital of Strausberg, we saw the need to acquire a 3D C-arm without navigation given the type of procedures we carry out in our department.

Initially, in 2008, we opted for the Ziehm 3D C-arm that we used for several years, with good 2D imaging but some limitations in the 3D image quality.

In 2022, we started tendering again for a new 3D C-arm, and after testing, I was pleasantly surprised by the image quality of OEC 3D.

Through my experience in trauma surgery, I tested several types of C-arm designed for 3D imaging where I have found that C-arms rotating more than 180 degrees provides superior 3D image quality.

During the renewal process, as we have relatively small surgical theaters, I wanted to verify that the new 3D C-arm could fit in the room for the different trauma procedures we do. We found that the size of OEC 3D is just the right one. Initially we had some positioning challenging with upper leg fractures close to the hip joint because there is relatively little space. We also had to rethink a few things in terms of setup, but after the initial phase we now have an easy workflow in 2D and 3D imaging. The multiplanar reconstruction (MPR) 3D images are produced relatively quickly in the intraoperative workflow. With

OEC 3D I believe we get the right balance of excellent in 2D and 3D imaging with a reasonable C-arm footprint even for our small operating room.

"Overall we can say that OEC 3D C-arm is easy to operate in 2D and 3D imaging and it provides us very good image quality for our procedures. These are the reasons why we decided to choose it for our daily practice."

Can you tell us for which procedures do you need 2D/3D imaging and what are the advantages?

In general, there is no such thing as emergency surgery without 2D/3D imaging. We use 3D imaging in about 5 percent of the surgical procedures we perform. For our other procedures we only use 2D imaging. This is mainly due to our concern for radioprotection, we use 3D imaging only when needed.

Considering the relatively small surgical theater we have; we cannot have one C-arm for 3D and another C-arm for 2D imaging. In addition, bringing the device in and out requires a certain amount of logistical effort that the OR staff wouldn't appreciate. We use OEC 3D for everything: 2D and 3D imaging.

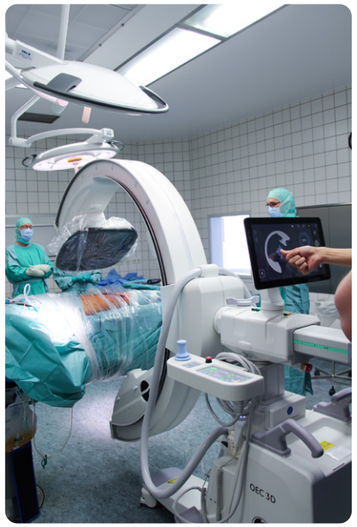
In our clinic we do about 20 tibial plateau fractures per year and another 20 tibial head fracture per year with 3D imaging. Tibia fracture reduction is one of the most complex procedures in traumatology. The volumetric images contribute to give us information on the anatomy behind the knee, that is difficult to perceive with 2D projection images.

So, my main indications for the use of OEC 3D for 3D imaging includes the surgery of the fracture of the tibial plateau at the level of the knee and ankle particularly when implying bone fusion. We also use 3D imaging for procedures of pelvic repair in geriatric patients. It is a procedure we performed with pelvic screws and cementoplasty. I check then, in the volumetric images, that the implants are in a good position. In spine surgery, particularly with kyphoplasty, sometimes I am not one hundred percent certain with 2D imaging, of the locations where the cement has flown out. I use 3D imaging in order to check that the cement doesn't go toward the spinal nerve and toward the spinal cord canal. It is fairly easy to correct after checking the 3D images. I also use 3D imaging in very complex fractures of the radius. The surgery of the elbow tends to be difficult technically, and 3D imaging is providing more information to get a better idea on how to proceed.

The advantage for me to do the intraoperative 3D imaging is simply to verify that I have reduced the fracture in an anatomically correct manner and that the screws are not too long. These are decisive advantages for me.

In the past, after doing the post operative CT scan control of one procedure of pelvic screw placement, we actually did have to correct the surgery. Obviously, I would not do that anymore now, because we can do 3D imaging during the surgery. That's the better solution. I consider that doing per operative 3D imaging during the procedure contributes towards minimizing the cost of the surgery. Revision surgery planned after CT scan requested because the patient feels pain costs money. When patients are in hospital for a certain time then it becomes uneconomical.

The goal of OEC 3D, with 3D imaging, is to be able to identify problems immediately and intraoperatively to avoid repeating interventions.



Starting 3D collision check on OEC 3D.



3D acquisition on going at 91% completion, projection images displayed on OEC 3D Touch View and Workstation.

Did OEC 3D require a special setup of the operating room or different set up for the procedure?

By experience I know that you should never start to operate and then look later at how to take X-ray images. Instead, we need to anticipate how to position the C-arm to get the working space needed during the surgery and sometimes you need to compromise in order to get the information you have to get.

In 2D imaging for example, I like to use the retrograde intramedullary nail fixation technique for humerus fracture reduction with freehand tightening. Patient lies in lateral decubitus, and in order to take profile views of his humerus we need to position the X-ray tube and the detector of the C-arm in the rainbow configuration, over the table. However, for this procedure we also need oblique views. We figured out how to position the patient far at the head end of the table and far away from the side of the table in order to do profile and oblique views in a comfortable way. With this setting we just sweep back and forth and move the C-arm along the table to get more anatomical coverage.

For 3D imaging, we didn't encounter major difficulties. For the procedures on the lower extremities of the patient we had to work more on the patient set up. We are used to position the contralateral leg outward and that's a bit tight when working toward the knee. In that case, we prefer to stretch the leg out lengthwise, and we accept the loss of image quality we might get from the attenuation of the X-ray beam from the contralateral leg. But as said, we figure it out before starting the surgery and it is not an issue.

How do you use OEC 3D imaging protocols and acquisition modes during surgery?

When doing 2D imaging, we select the imaging protocol depending on the anatomy. We work on orthopedic, or spine imaging protocol. We set up



Dr Koenig reviewing MPR images on OEC 3D workstation

OEC 3D to low dose mode at its boot up and rarely change otherwise the settings as the system adapts automatically in real time. We like the image quality in 2D we get with this set up.

When doing kyphoplasty, we also like to use the C-arm angulation memorization fonction. Once we identified for the patient the hip oblique views, we store the angulation values and recall them. That's valuable for the staff and the learning curve has been relatively quick.

We generally only run one 3D scan per patient for radiation exposure reasons. After reduction of the fracture and securing the osteosynthesis material put in place, we run a 3D scan before we do the final osteosynthesis. Sometimes, if the screw lengths have to be verified, then we perform another 3D scan. It is also the case if the patient suffers from discitis and we are trying to repair and shape the vertebrae, a second 3D scan can allow us to check whether if the bones are in the correct position. The 3D scan is generally performed before the final implant is inserted during the procedure or otherwise at the end of the procedure.

We run 3D acquisition in High Definition (HD) mode, and we activate the Metal Artefact Reduction (MAR) function if needed.

> *"The positioning of the C-arm is fairly easy without dose as we like to use the 2 laser aimers to adjust the C-arm detector over the anatomy of interest."*

When we run the 3D acquisition scan, the anesthetist stays in the corner of the room so that he can see the patient, and I usually stay at a safety distance of four meters from the C-arm. I do this because when I run the 3D scan, I always look at the images of projection that are acquired in real time because this loop of images provides me with additional information.

For image review, I like to manipulate myself the 3D images on the 3D volume viewer of the workstation. I know what I am looking for and I can review the information directly using the multi oblique view function without asking anyone.

The large size of 3D volume 19 by 19 by 19-centimeter cube is an advantage for our procedures. In particular it is interesting when we are placing pelvic screws. The 3D volume we had before with our previous C-arm was definitely not sufficient. I am really interested to get volumetric images of the sacrum, to check how the wires are positioned, how the screws could be placed later on during the procedure.

OEC 3D user interface and 3D workflow were new to me and to our team but the learning curve was quite fast as the design is intuitive. Our OR staff are running the 3D collision check, under supervision of surgeons and guided by the 3D set up assistant.

The OEC 3D C-arm is rather compact for a 3D C-arm, and its C in carbon fiber has the good size for our work. It is the type of design we will need more and more in the future, with an image quality that looks more like the one of intraoperative CT scanner.

OEC 3D C-arm is easy to operate and it is very good quality. These are the reasons why we decided to choose it for our daily practice.



Dr. Steffen Koenig is an orthopedic surgeon specialized in emergency surgery. After completing his medical studies at the Humboldt University in Berlin, he specialized as an orthopedic surgeon at the Wriezen Hospital. In parallel he spent one year in Frankfurt/Oder to start his specialty in emergency surgery and he has been doing emergency surgery exclusively since 1999.
Dr. Koenig worked as a senior physician at the Märkisch-Oderland hospital in Wriezen, at the Northwest Hospital in Frankfurt am Main, and at the Lahr/Ettenheim Hospital in Baden before joining the Märkisch-Oderland hospital in Strausberg, where he has been Chief Physician head of the department of traumatology and reconstructive surgery since 2008.
Dr Koenig also completed a Master of Business Administration (MBA) in healthcare management in Dresden.
He is Vice President of the Brandenburg State Medical Association and, in line with the position of Medical Director of the hospital, he is also second Chair of the association Marburger Bund Berlin Brandenburg.
He actively contributes to orthopedic and trauma education of his pairs as a member of committees and standing conferences of the German Medical Association in the field of the Deutsche Akademie der Ärzte (German Academy of Physicians). Dr Koenig also sits on the administrative committee of the medical pension scheme.

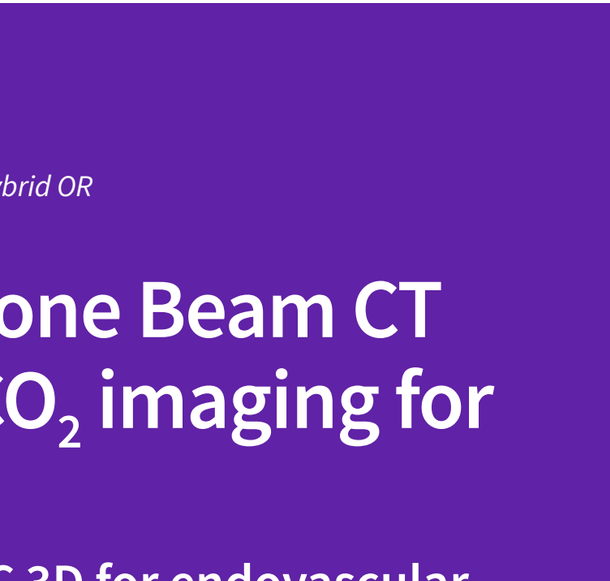
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Advanced imaging tools in mobile Hybrid OR

Benefits of Cone Beam CT (CBCT) and CO_2 imaging for EVAR

Experience with OEC 3D for endovascular aortic repair (EVAR)

With the courtesy of Pr. Jonathan Sobocinski, vascular surgeon, Head of Department of Vascular and Endovascular Surgery, Dr. Maxime Lebaz and Dr. Zoe Ribreau, vascular surgeons, Aortic Center, Lille University Hospital, France



Pr. Sobocinski and GE HealthCare are exploring the benefits of CMOS flat panel technology in mobile C-arms for 2D fluoroscopic imaging and mobile Cone Beam CT (CBCT) imaging in endovascular surgery. Pr. Sobocinski shares his experience with OEC 3D in his ongoing clinical work.

The University Hospital of Lille is one of the largest university hospitals in France with 2500 beds. The department of vascular surgery hosts 50 beds and 3 operating rooms (ORs). Two of the OR's are equipped with mobile imaging systems, and one is equipped with a fixed system. The vascular department handles about 2000 arterial cases every year. One of the team's objectives is to apply the ALARA ("As Low As Reasonably Achievable") principles to reach the best compromise between radiation exposure, use of iodine contrast media, and surgery outcome.

In this article, Pr. Sobocinski, Dr. Ribreau and Dr. Lebaz describe two EVAR clinical cases with 2D fluoroscopic images and mobile CBCT scans performed with OEC 3D and in the second case their experience with CO2 contrast media.

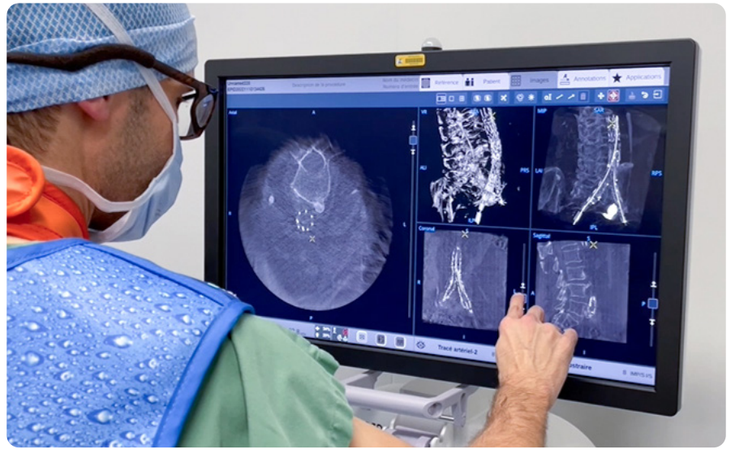


Figure 1: Pr. Sobocinski reviewing mobile CBCT scan images on OEC 3D workstation after the procedure.



Figure 2: Dr. Ribreau with OEC 3D

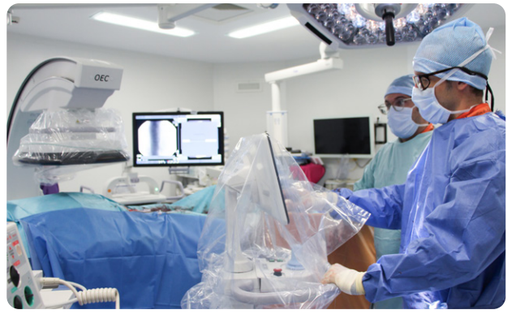


Figure 3: Pr. Sobocinski and Dr. Lebaz with OEC 3D Touch Table Side.

EVAR: Infrarenal stent graft with left iliac branched device

Presented by Dr. Maxime Lebaz, Dr. Zoe Ribreau and Pr. Jonathan Sobocinski, vascular surgeons, Aortic Center, University Hospital Lille, France.

Clinical Aspect

Over the last decade, endovascular aortic repair has become the preferred surgical technique to treat aneurysm and dissection. Patients' selection relies on strict anatomical criteria. The preoperative planning of the procedure includes careful analysis of the morphology of the aortic lesion and the ilio-femoral access. The technical feasibility and the stent graft sizing are then subsequently determined. The procedure is performed under fluoroscopy guidance, and the X-ray dose delivered throughout the procedure depends on the complexity of the navigation (calcification, tortuosity, diameter) and patients' morphotype.

When such procedures are performed with a fixed imaging system, routine CBCT scans are completed at the end of the procedure to ensure proper integrity of the stent graft and to depict any conflict on the devices implanted. These intraprocedural acquisitions secure the quality of the arterial reconstruction and have proven reduction in early and late reinterventions[1].

1 [Lerisson E, Patterson BO, Hertault A, Klein C, Pontana F, Sediri I, Haulon S, Sobocinski J. J Vasc Surg. 2022;75:1021-1029.e2]

Technical Solution

OEC 3D is developed by GE HealthCare. OEC 3D is a mobile C-arm with 2D and 3D CBCT imaging using CMOS flat panel technology.

The OEC 3D C-arm provides a 19 cm x 19 cm x 19 cm high resolution 3D volume within 30 seconds of image acquisition, including up to 400 images with 3 different acquisition modes (Standard, High Definition and High Definition +). Integrated processing algorithms can smooth metal artifact (Metal Artifact Reduction) and reduce surrounding noise (enhanced Noise Reduction).

The user interface to plan and perform the 3D acquisition sweep (3D Setup Assistant) is easy to use: biplane lasers and a collision check step allow for a precise centering of the anatomy in the 3D volume. A 200° sweep of the C-arm collects 3D data in 30 seconds (3D data acquisition step). An additional 30 seconds of data reconstruction occur before display of volumetric images on the video monitor of the workstation.

The surgical table used is ImagiQ2™ (Stille AB, Solna Sweden).

The patient here is an 88 year-old with a large (80 mm) infrarenal abdominal aortic aneurysm extended to the left common iliac artery.

Case & Procedure

The treatment proposed was an endovascular exclusion of the aneurysm with an infrarenal stent graft in addition to a left iliac branched device to seal its left distal part within the external and the internal iliac arteries [Gore Excluder AAA Endoprosthesis, and Gore Excluder iliac branch endoprosthesis, W.L. Gore & Associates, Flagstaff, Arizona, USA].

The best projection to optimize the visualization of the origin of the lowest renal artery and iliac bifurcations were assessed from the preoperative computed tomography angiography (CTA).

The procedure was performed percutaneously under general anesthesia. The iliac branched device was first deployed associated with the bridging graft to ensure sealing in the internal iliac artery. Then, the positioning of the main bifurcated aortic body before deployment was checked with a short angiogram of 7 cc (cubic centimeters) of contrast media at the origin of the lowest renal artery. The subsequent usual steps of the procedure were achieved without any particular issue and iliac limb extensions were deployed in order to ensure optimal overlap between graft components on the left handside and sufficient application within the native right common iliac artery. A final 2D DSA (digital subtracted angiography) with 25 cc of contrast media confirmed aneurysmal exclusion, the renal and hypogastric arteries and stent graft patency.
A mobile CBCT scan with no injection was then completed.

The entire procedure lasted 100 minutes. The total fluoroscopy time of the procedure was 19 minutes, with a total Dose Area Product (DAP) of 44.445 Gy.cm² and the total amount of contrast injected was 40 cc [Xenetix® 300mg/dl (Guerbet, France)].

Volumetric images acquired with OEC 3D at the end of the procedure

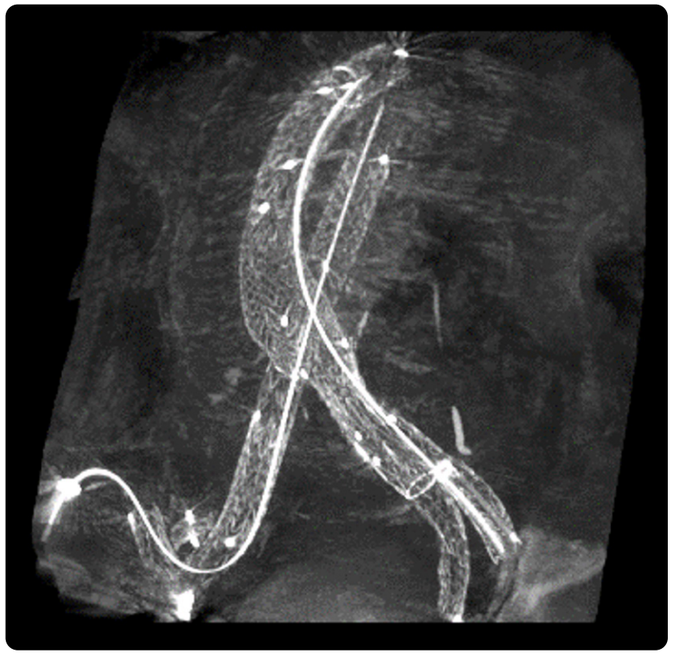


Figure 1: Maximum Intensity Projection (MIP) view of the case – data obtained with OEC 3D and displayed with the 3D volume viewer of AW plateform

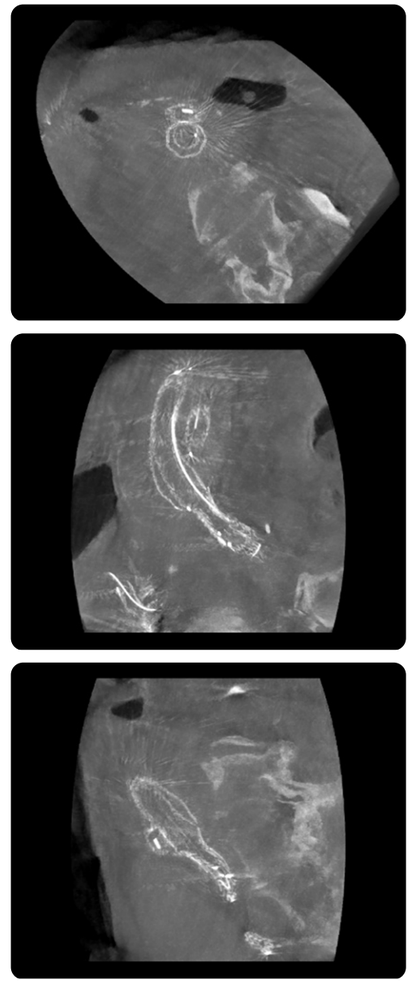


Figure 2: Maximum Intensity Projection (MIP) view of the case – data obtained with OEC 3D and displayed with the 3D volume viewer of AW plateform

Specific featuring

The OEC 3D mobile CBCT C-arm is similar in terms of use and workflow to the OEC Elite CFD C-arm. The entire 2D fluoroscopic imaging procedure was completed in low dose and pulsed mode (8 pulses per second (pps)). At the beginning of the procedure the automatic storage of all fluoroscopic acquisitions was activated (dynamic recording): it reduces the need of DSA acquisitions along the procedure.

For the 3D acquisition, the '3D Setup Assistant' software guides the user through 4 steps: patient orientation and imaging mode selection (step 1), centering the anatomy in the 3D volume (step 2), collision check (step 3), and 3D acquisition (step 4).

After 30 seconds (duration of the 3D volume reconstruction) the volumetric images are displayed, and the Volume Viewer automatically opens with a suite of 3D imaging tools based on GE HealthCare AW image fabric.

The Volume Viewer displays 5 volumetric images on the monitor screens: cross sectional planes (axial, coronal, sagittal), volume rendering (VR) and maximum intensity projection (MIP).

The Volume Viewer's tools enable the user to choose the display mode options and several tools for viewing images of cross-sectional planes (such as Multi Oblique Mode, scrolling through slices, slice thickness adjustment, window level, zoom, measurement, annotation and image storing). For VR and MIP images it also allows users to rotate the image.

Conclusion

Introducing the possibility of completing an intra operative mobile CBCT scan with OEC 3D offers additional safety during EVAR.

Moreover, the mobile CBCT scan feature in OEC 3D is an easy-to-use tool with short learning curve for surgeons.

The 3D images obtained provide a reliable assistance for checking the quality of the endovascular exclusion and might alleviate the postoperative imaging follow-up requirements.



Figure 3: Dr. Lebaz using OEC 3D Touch Table Side from sterile field

Introducing CO_2 in the aorto-iliac region

Courtesy of Dr. Maxime Lebaz, Dr. Zoe Ribreau and Pr. Jonathan Sobocinski, Vascular surgery, Aorta Center, University Hospital Lille, France.

CO_2 is a gas 20 times more soluble in blood than oxygen and can be used in endovascular procedures as a contrast agent to help in navigation and assess vessel patency. CO_2 is eliminated by lungs and represent an alternative to iodized contrast agents in patients with renal dysfunction. CO_2 injections can be associated with potential side effects reported as cerebral gas embolism and general discomfort. There is no specific dose threshold as long as an appropriate interval is maintained between two injections and the injection should be in the vessels below the diaphragm. The injection is performed using a dedicated automatic injector. Since CO_2 is less dense than iodine contrast media (ICM), its X-ray absorption coefficient is lower, and requires a specific image processing in the different types of image acquisitions.

We present here the case of an octogenarian patient with known severe renal insufficiency with an estimated Glomerular Filtration Rate (eGFR) at 41 ml/min where was incidentally diagnosed a large aneurysm (10 cm in diameter) in his left common and internal iliac arteries. Considering the location of the aneurysm and the patient's medical condition, an endovascular exclusion guided with CO_2 as a contrast agent was performed.

The procedure included the embolization of the distal branches of the left hypogastric artery and the implantation of a bifurcated infrarenal stent graft with a left external iliac extension covering the origin of the hypogastric artery. The embolization enclosed the implantation of an Amplatzer AVP2 plug (Abbott) in one of the main distal branches of the hypogastric and was completed by pushable coils in other small branches [Concerto coils (Medtronic)]. Subsequently, after visualization of the lowest renal artery with a CO_2 aortography (volume and flowrate to be provided and administrated by the Angiodroid injector (Bologna, Italy)), a bifurcated infrarenal stent graft (RLT261412, Gore) was implanted. A final 2D angiography (25cc of ICM at a 15cc/sec) to assess the patency of the stent graft and potential perigraft leak was performed. A mobile CBCT scan using the high-definition mode of the OEC 3D was completed additionally and depicted constraints by the aorto iliac native bifurcation on both limbs of the stent graft requiring additional kissing stent (BeSmooth, Bentley).

The total procedure duration was 120 minutes, with 900 ml of CO_2 injected and a cumulated dose area product of 27,25 Gy. cm^2; the global amount of ICM injected was 25 cc.

The postoperative course was uneventful, and the eGFR at discharge was 48mL/min.

2D fluoroscopic imaging

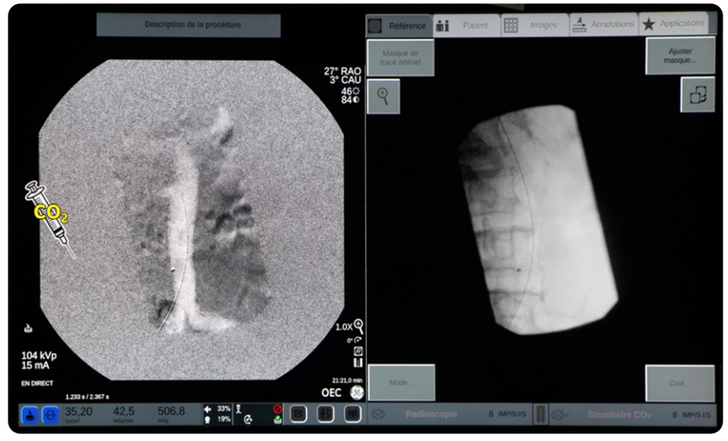


Figure 1: OEC 3D workstation monitors displaying initial DSA performed with CO_2 contrast agent

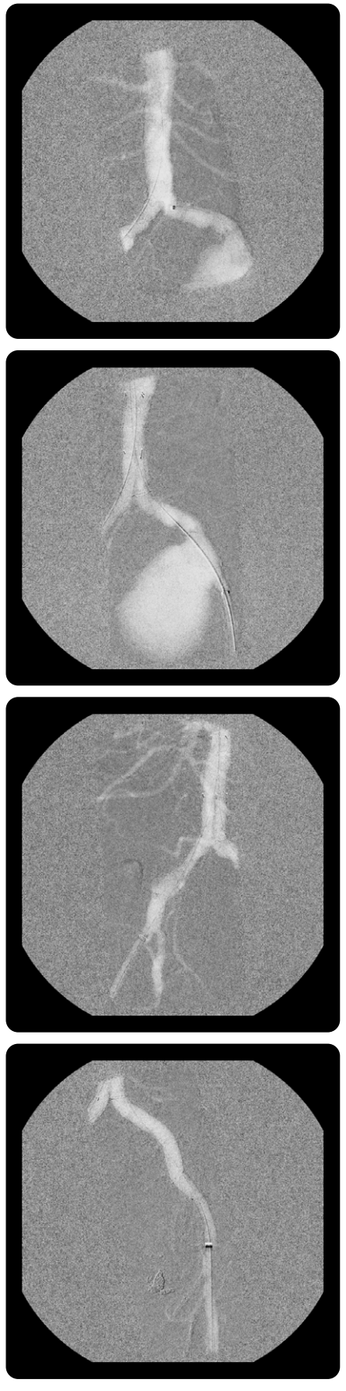


Figure 2: Peak opacification masks performed with CO_2 along the procedure

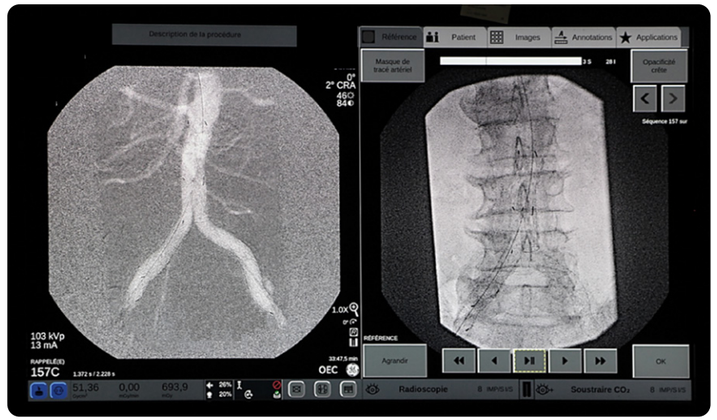


Figure 3: OEC 3D workstation monitors displaying final DSA performed with CO_2 contrast agent

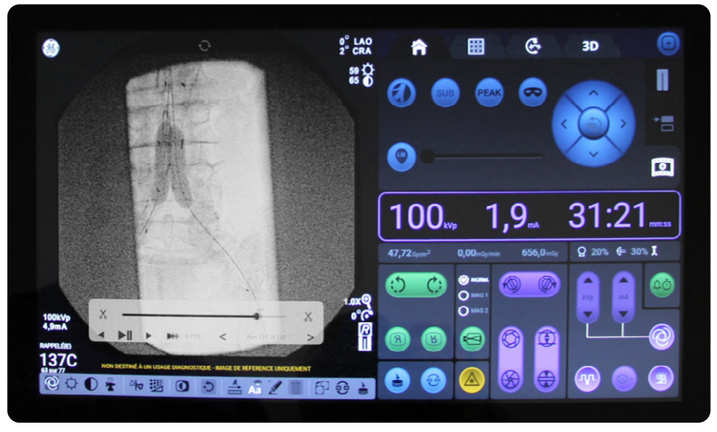


Figure 4: OEC 3D TouchView showing kissing balloon step of the procedure

Volumetric images acquired with OEC 3D at the end of the procedure

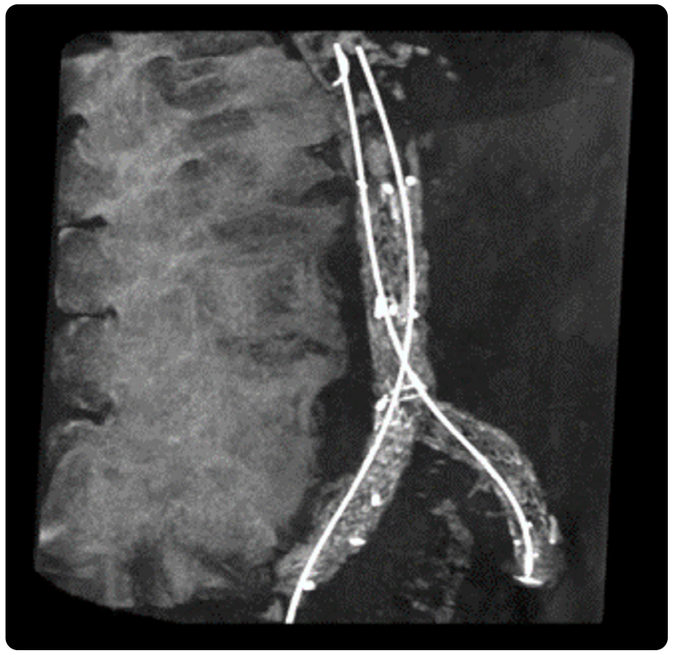


Figure 5: Maximum Intensity Projection (MIP) view of the case – data acquired with OEC 3D

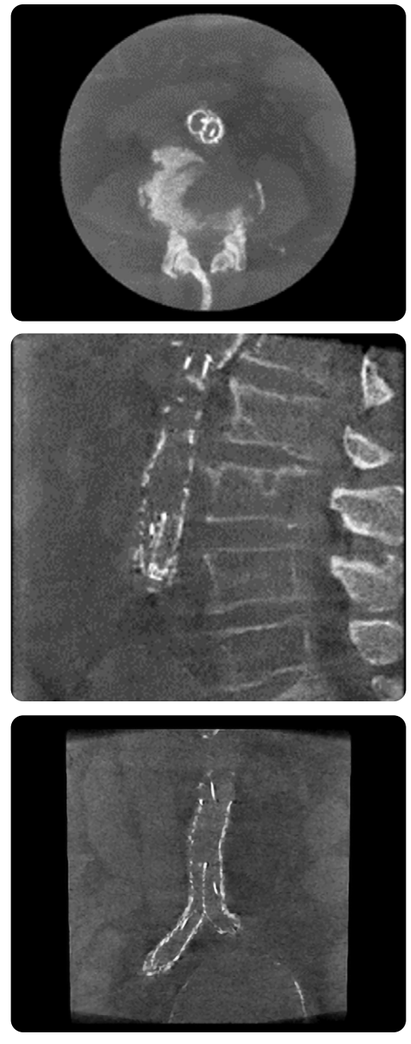


Figure 6: Multi oblique views of the case – data acquired with OEC 3D

Pr. Sobocinski is a paid consultant for GE HealthCare and was compensated for participation in this testimonial. The statements by Pr. Sobocinski described here are based on his own opinions and on results that were achieved in his unique setting. Since there is no "typical" hospital and many variables exist, i.e. case mix, there can be no guarantee that other customers will achieve the same results. OEC 3D is a mobile 3D/2D C-arm that provides intraprocedural mobile CBCT scan images and 2D fluoro images to enable visualization of anatomical structures during diagnostic, interventional, surgical, and minimally invasive surgery procedures such as endovascular procedures. JB28597XX

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