OEC MAGAZINE

Innovation in Surgical Imaging with OEC C-arms

#MINIMALLY INVASIVE SURGERY

#ENDOVASCULAR SURGERY

#ADVANCED ENDOSCOPY SURGERY

#CMOS - FLAT PANEL TECHNOLOGY BENEFITS

#EXCEPTIONAL PRACTICES

Magazine #1

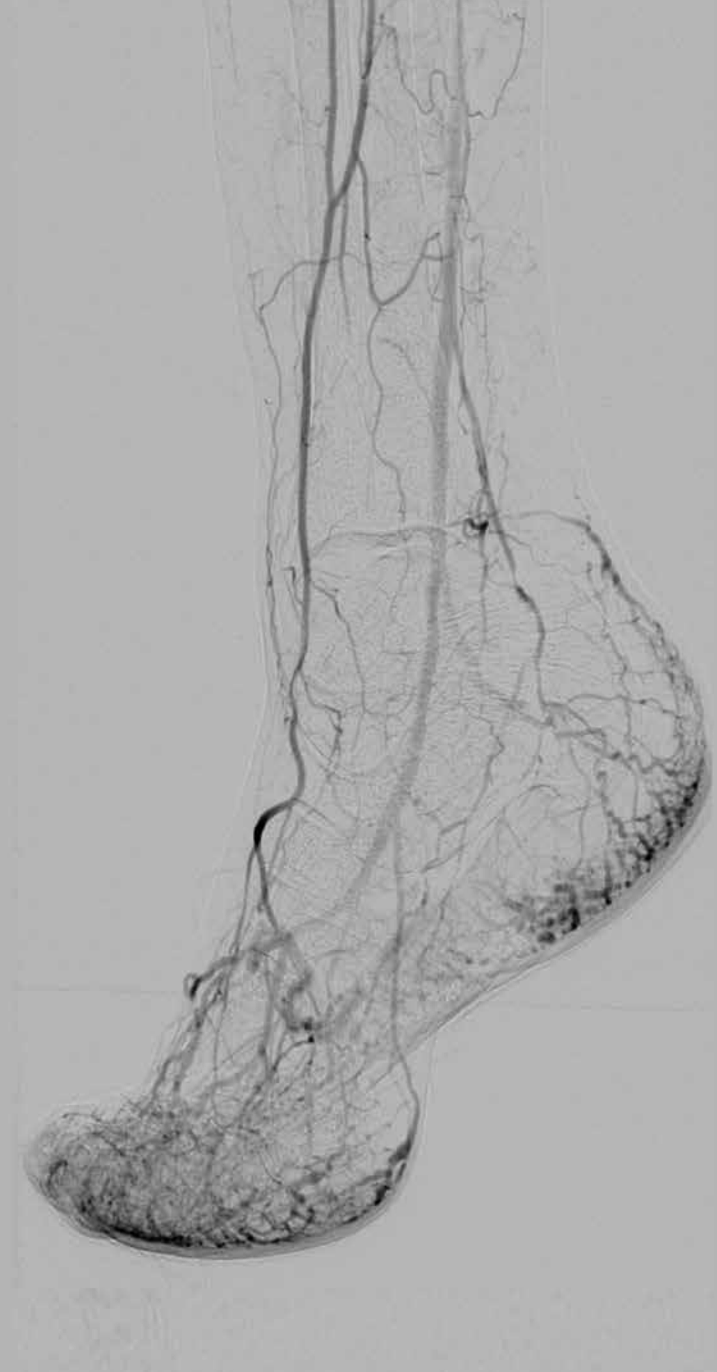

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Photo: Shutterstock (#153741113) - p.40

Dear reader,

GE Healthcare is dedicated to help the transformation of patient care by providing THE "imaging guidance platform" for the Operating Room.

With the OEC C-arm platforms and advancements in mobile X-ray detector technology and innovative ergonomics, we provide practical solutions that aid in patient care during surgical procedures.

The rapidly increasing demand from patients undergoing minimally-invasive surgical procedures, especially with the increasing geriatic population, and the surge in the many clinical domains like vascular, colorectal, and other gastrointestinal diseases drives the need for innovation in surgical imaging.

Our OEC family of mobile C-arms has been used by surgeons for more than 40 years. We have delivered innovation with more than 35,000 systems installed worldwide. You demand clinical and operational excellence ... and we help you achieve this with surgical precision.

With the launch of our latest CMOS flat panel C-arm platform, the OEC Elite CFD offers stunning image clarity and detail at low dose with enhancements for an easy and efficient experience.

In this edition of our OEC Magazine, you will find exclusive testimonials of several of our clients who have recently implemented innovative imaging solutions in their daily practice.

We hope that these testimonials will be of inspiration to your current or future practice in improving image guided therapy in various fields of application.

With our best regards

Jean-François Drouet
Image Guided Therapy
Marketing Europe

Christoph Obermeier
Surgery Marketing Manager Europe

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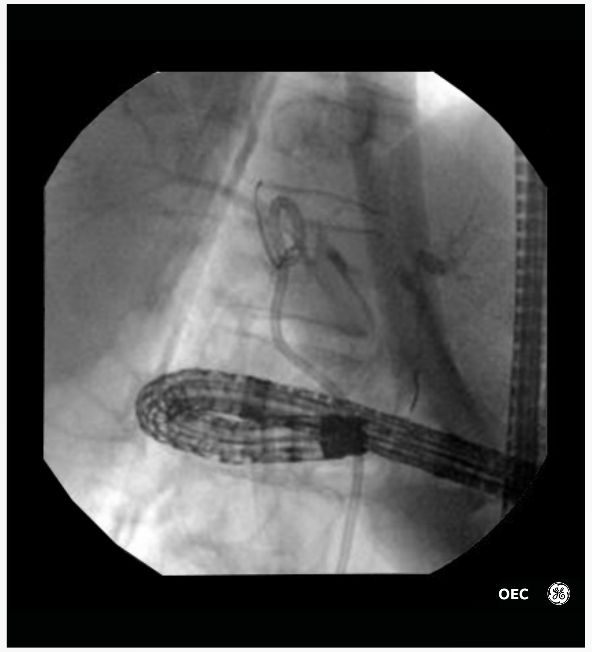


Strategic expansion with an endovascular suite in the OR Clinique Rive Gauche Toulouse (France)

Experience of Dr. Laurent Casbas, Vascular Surgeon

The first OEC Elite CFD Vascular with CMOS detector in Europe[1]

Clinique Rive Gauche in Toulouse, France has been rated one of the best private hospitals in France for vascular surgery.[2]
Dr. Casbas and two other surgeons are performing vascular and endovascular interventions in the same operating room.
The investment in the mobile endovascular suite within the operating room is part of the strategic plan of the hospital to serve the local community in downtown Toulouse for diagnosis and treatment of vascular disease.

Clinique Rive Gauche in Toulouse, France began using the OEC Elite CFD in September 2017 and was the first institution in Europe to perform vascular surgery on the newly launched platform with 31cm CMOS detector technology.

The surgeons are performing a wide variety of endovascular procedures and investing in a high performance mobile C-arm has been key in their strategic plan to keep up with increasing patient volumes.

Performance was essential for this investment, but flexibility was also a key factor: this operating room is part of the general surgery building and thanks to the mobility of the imaging equipment, any surgery can be performed in the room, be it open or endovascular surgery, although it is mainly dedicated to vascular interventions.

Dr. Casbas and the team selected the OEC Elite CFD due to both its superior, high-resolution image quality; achieved through the new CMOS detector technology, and system ergonomics.

The OEC Elite CFD is easy to position and is equipped with a large C-depth. This design allows for ease of movement in the smallest of working spaces.

Dr. Casbas:
"The OEC Elite CFD has allowed us to build an endovascular suite with practically the same performance as our fixed interventional lab in the other building, but located here in our operating room suite. The image quality for our vascular procedures is excellent. Combined with our free floating carbon fiber table and large image display we have a very complete vascular room, but the room can be fully used for any other type of surgical procedures as all devices are mobile and can be moved in or even out of the room.

This latest generation platform with the flat detector and specific OEC design allows us to have a larger field of view with more anatomical coverage than before. Access to previous exams and recordings in the procedure is fast and easy which allows us to avoid or reduce X-ray dose and contrast media usage for the patient.

These innovations allow our medical team and surgeons to perform complex interventions in an optimal environment in our operating room."

Performing a peripheral vascular procedure with the OEC Elite CFD. All devices are mobile for full flexibility to use the room for open or endovascular surgery.

Performing an endovascular repair procedure.

[1] Clinique Rive Gauche, press release " 3 avril 2018 : La clinique Rive Gauche s'équipe d'un nouvel arceau de chirurgie mobile de dernière génération"
[2] https://www.lepoint.fr/palmares-hopitaux/exclusif-les-50-meilleures-cliniques-de-france-23-08-2017-2151792_41.php
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.

Advanced fluoroscopy-endoscopy hybrid room for pancreaticobiliary treatment: an innovative experience

Experience of Dr. Fredrick Swahn at Skane University Hospital - Lund

With the expansion of surgeons training in endoscopy imaging and the broadening of the endoscopist's skills to endoscopic ultrasound (EUS), Endoscopic Retrograde Cholangio Pancreatography (ERCP) procedures are increasing and transitioning from diagnostic to therapeutic indications.[1] Modern guidewire procedures including biliary cannulation, pancreatic stenting, and, Endoscopic Papillary Large Balloon Dilatation (EPLBD), require the capacity of a hybrid room, integrating advanced endoscopy with high image quality fluoroscopy.

Efficiency and progress of ERCP

In 2018, the 50th anniversary of the first ERCP procedure performed by Dr. William S. McCune in Washington DC, was celebrated in Malmö (Sweden).

The role of ERCP in the management of pancreaticobiliary diseases has been increasing and strengthened by other techniques such as Endoscopic Ultrasound (EUS) and more recently direct visualization systems allowing intraductal endoscopy. The positioning of these very thin instruments is performed under fluoroscopy with contrast media injection to visualize the biliary and pancreatic ducts. The final control, performed taking a fluoroscopic image, is stored in the patient file for follow up.

The Surgery department of Lund University Hospital chose the OEC Elite CFD C-arm for its advanced hybrid room equipped with intraductal ERCP procedure capability.

High image quality fluoroscopy from the CMOS flat panel detector was the determining criteria for Dr. Swahn for selecting the OEC Elite CFD C-arm system. Guidance of devices and stents of a couple of millimeters in diameter into the biliary and pancreatic ducts requires high image resolution and contrast in soft tissues.

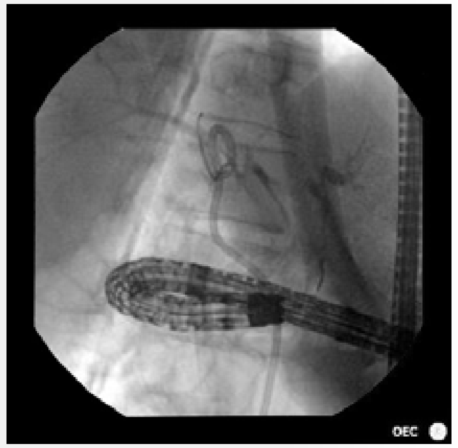
"For this room, we needed a C-arm with excellent X-ray image quality at low dose imaging. It is one of the essential things you need to have when performing advanced endoscopy and ERCP procedures." Dr. F.Swahn

High-resolution fluoroscopic guidance

Complex pancreaticobiliary system treatment is permitted by the use of a direct visualization system (SpyGlass® Boston Scientific). This instrument is introduced into the pancreaticobiliary tracts through the duodenoscope positioned at the level of the major duodenal papilla. A catheter is then slowly inched into the duct and through which either electrohydraulic lithotripsy (EHL) or laser lithotripsy (LL) devices can be introduced. Intraductal biopsies can also be performed with forceps or brushes through this catheter.

If the duodenoscope guidance to the major duodenal papilla can be performed with traditional fluoroscopic imaging, the introduction and motion of the direct visualization system and its tools require high-resolution fluoroscopy with high contrast sensitivity given the small size of the tool.

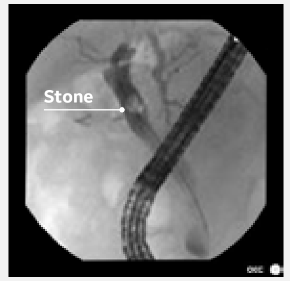
Dr. Frederik Swahn:
"The OEC Elite CFD C-arm is a very good work horse. It provides the best X-ray images I have seen in mobile C-arm flat panels."



Biopsy brush

Stent implantation into biliary duct for drainage soft tissue resolution

Initial cholangiogram showing the stone



Cholangiogram displaying stone progression toward papilla

Large balloon inflated in duodenal papilla

Control cholangiogram after bile duct drainage with small balloon

High soft-tissue contrast fluoroscopy

Complex ERCP in the pancreaticobiliary system often involves interventions such as ballooning, brush biopsies or drainage stenting. At this point of the procedure, fluoroscopy is the usual method to guide and control the placement of these devices. In the abdominal belt of the patient, which consists of diverse densities such as bone, muscles, air, and fat, the challenge is then to identify thin or low-density devices.

As the handling of the duodenoscope and its tools is complex, fluoroscopy with high spatial resolution in diverse soft tissue densities, without manual adjustment, is a clinical added value that contributes to achieving a positive patient outcome. Today, endoscopic devices and tools do not always address the procedure's needs.

Many developments are ongoing to increase access to the targeted anatomy in a simpler and faster way.

For further improvement of the procedure, the fluoroscopy-endoscopy hybrid room would benefit from an even higher level of integration of the different minimally-invasive navigation techniques and a more integrated workflow across the equipment.

Dr. Fredrik Swahn is a gastroenterology surgeon, specializing in advanced ERCP endoscopy techniques. After fourteen years of practice in Karolinska University Hospital, Stockholm, he joined Lund University Hospital in 2015, to develop advanced endoscopy surgery.

1. Kozarek 2016 | R Kozarek et all. The future of ERCP. Endoscopy International Open 2017; 05: E272–E274

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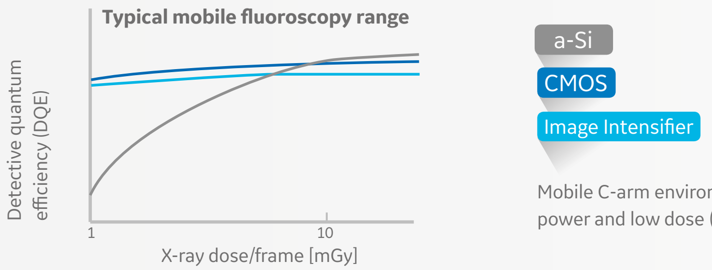
JB60571XE

OEC ELITE™ CFD CMOS FLAT PANEL DETECTOR

The crystalline structure of CMOS required engineering innovations to manufacture for large detector sizes. For the first time, we're bringing this innovative technology to premium C-arm systems.

DELIVERS HIGH IMAGE QUALITY AT LOWER DOSES



Mobile C-arm environment characterized by low power and low dose (photon starved)

★ IMAGE QUALITY AT LOW DOSE

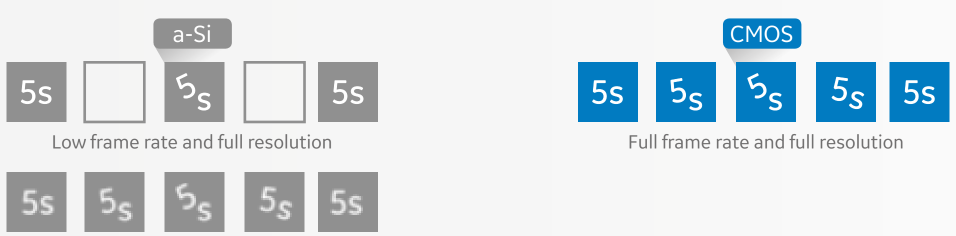
SMOOTH MOTION WITHOUT GAPS BETWEEN FRAMES

Lag or ghost movement of second hand

Smooth movement of second hand

★ NO VISIBLE LAG OR GHOSTING

NO COMPROMISE BETWEEN FRAME RATE AND RESOLUTION



Low frame rate and full resolution

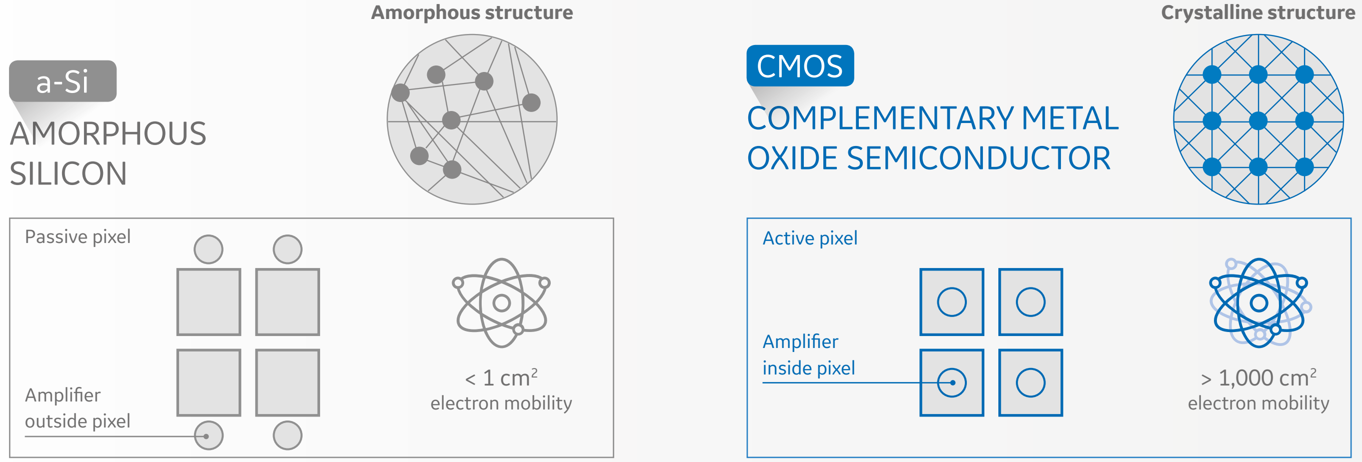
Full frame rate and full resolution

-or- Full frame rate and low resolution due to binning

★ FULL FRAME RATE AND FULL RESOLUTION AT 30 FPS

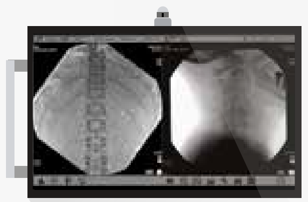
SEE THE CRYSTAL CLEAR ADVANTAGE

The material used in a flat panel detector for mobile C-arms to process image data matters. It determines important variables like speed and data integrity. For mobile C-arm images, these variables traditionally translate to image quality and dose trade-offs.

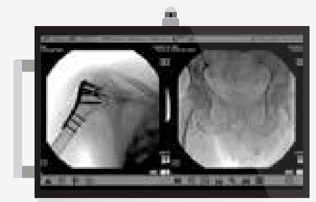


STUNNING IMAGE QUALITY-LOW DOSE

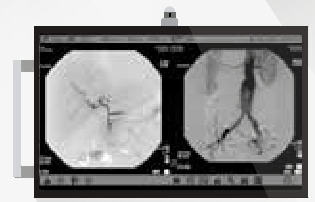
Empowered leading technology, the OEC Elite CFD delivers stunning image quality at a low dose as well as a large field of view with CMOS flat panel detectors (available in 21 and 31cm sizes). A 4K ultra-high definition 32" monitor displays images with one-for-one detail from the detector.



Spine



Orthopedic



Vascular

JB63763XE

Active Pixels in CMOS Flat Panel Detectors Eliminates Visible Lag

The OEC Elite CFD C-arm Images at 30 fps and Full Resolution Without Visible Lag

Contributor: David Barker, Chief Engineer, Surgery, GE Healthcare

Purpose:
This white paper examines how the architecture of active pixels, such as those used in complementary metal-oxide semiconductor (CMOS) image detectors, reduce visible lag as contrasted with passive pixels, such as those used in amorphous silicon (a-Si) detectors.

Introduction

X-ray imaging technology has taken a leap forward with the introduction of CMOS flat panel detectors. The superior electron mobility of the crystalline structure means that small, active pixels can replace the passive pixels used in a-Si flat panel detectors. One of the many benefits of active pixels is reduced or eliminated visible lag, the after-images of previous frames that distort the displayed anatomy. Eliminating lag provides value for a number of reasons:

• No lag means clearer, more accurate images for healthcare providers, allowing them to work with greater speed and accuracy.

• Full frame rate images, uncompromised by lag, give providers a smooth view of motion within the visualized area, so they are able to operate with greater efficiency.

This paper provides specific technical information about the architecture of both active and passive pixels and explains the limitations of passive pixels that result in visible image lag. It also examines why active pixels eliminate visible lag.

Background and Challenge

The OEC Elite CFD obtains X-ray images by first converting high energy X-ray photons into visible photons through a Cesium Iodide (CsI) scintillator, then allowing the visible photons to be captured by a CMOS flat panel detector. Lag is typically defined as the persistence of luminescence after X-ray stimulation has ended. The lag due to a CsI scintillator that converts X-ray photons into visible light is on the order of only 1 ms [1].

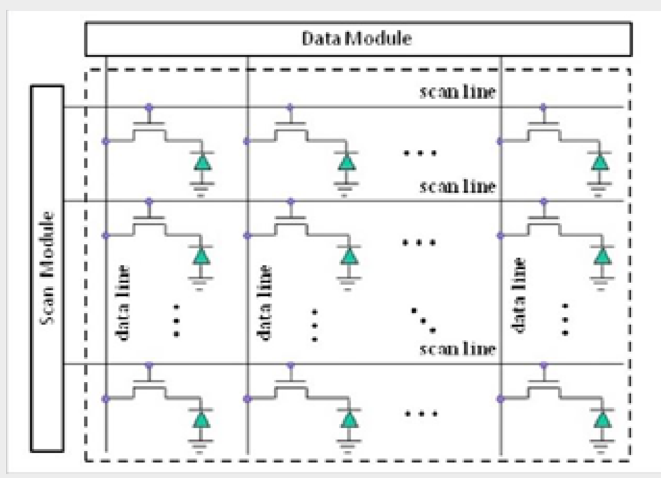


Fig.1: Amorphous silicon (a-Si) passive pixel detector design. Passive pixels lack the mechanisms to read and recharge quickly enough to deliver lag-free images at full frame rates (30 frames per second).

This means that any visible lag effects such as persistent blur or ghosting are governed by the flat panel detector technology that converts visible photons into digital signals.

Since amorphous silicon (a-Si) detectors suffer from poor electron mobility due to the random nature of the material, the photodiodes occupy a much larger space compared to those fabricated by using CMOS [2]. Because of these space limitations, a-Si-based X-ray detectors are designed with passive pixel architecture.

As shown in Figure 1, a passive pixel has only two elements: a thin-film transistor and a photodiode. The pixel array can only be accessed one row at a time, which limits the readout speed.

A passive pixel has only two states: charging and discharging. The arriving X-ray photons are converted into light photons by the scintillator of the X-ray detector. The photodiode then converts the light photons to electrons which discharges the capacitor of the pixel. The system “reads” the pixel by recharging the photodiode and measuring the number of electrons refilled, which correlates to the number of X-ray photons the pixel received. of the respiratory tracts requires high image resolution and contrast is for the navigation guidance.

The process of reading/recharging a pixel can be described by an R-C circuit, shown in Figure 2.

The resistor in Figure 2 includes the resistance of the data line as well as the resistance of the thin-film transistor in its “on” state. The capacitance in Figure 2 is the sum of the capacitance of the photodiode plus the data line distributed capacitance.

The charging voltage is an exponential

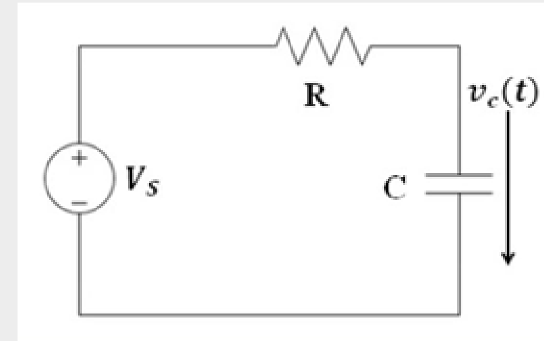


Fig.2: F R C circuit analog of an a-Si pixel.

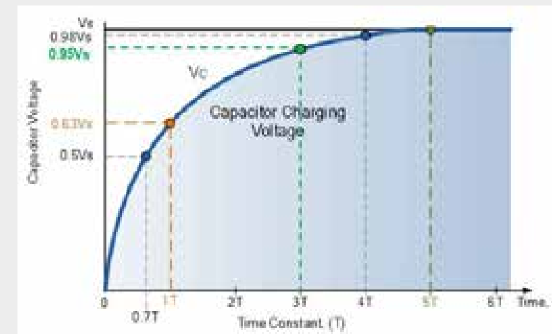


Fig.3: Capacitor charging curve based on time constant T. For a passive pixel to deliver a lag-free reading, it has to have time to charge fully. Most a-Si detectors are unable to overcome this constraint.

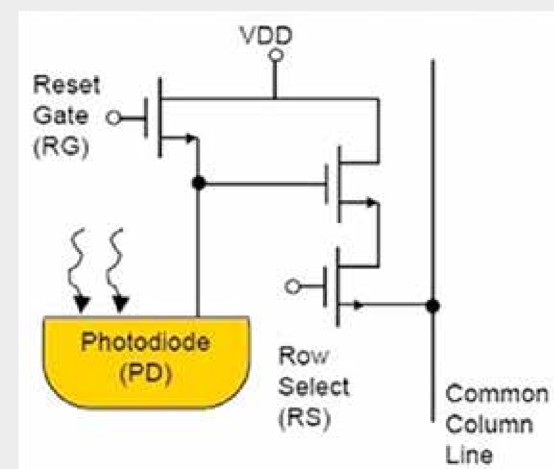


Fig.4: CMOS active pixel. Active pixels, which are smaller and more complex than passive pixels, have amplification, readout, and reset mechanisms built into the pixel itself.

function of the charging time. That is, **(t)** = $V_S [1-e^{-(t/T)}]$ where **T = RC** is the R-C constant. As Figure 3 shows, $V_C(3T) = 95\% V_S$ and $V_C(4T) = 98\% V_S$; this figure displays the change in charging voltage over time.

The remaining 5% in the **t = 3T** case and the remaining 2% in the **t = 4T** case becomes the image lag in the following image frames. That is why a 2%-5% first frame lag is typically observed in a-Si based X-ray detectors.

In addition, frame rate—the number of frames that an X-ray detector can acquire in the time period of a second—influences image quality. a-Si detectors do not have time to fully charge the photodiode to avoid the R-C lag. For example, achieving 30 frames per second (fps) means there is only 1000 ms / 30 = 33 ms to expose the entire pixel array with X-rays and to read all the pixels in the detector. For a 10 ms pulse-width X-ray pulse, the detector readout time must be within 33 ms − 10 ms = 23 ms.

Assuming that the pixel array has 1536 rows with data modules on both the top and bottom of the detector, allowing the pixel array to be read in parallel, the readout time per pixel must be less than 23 ms / (1536 / 2) = 0.03 ms or 30 µs. As a result of this limitation, many of the a-Si based X-ray detectors may not be able to support a frame rate of 30 fps. For instance, the highest frame rate currently supported by the Ziehm Vision RFD system is 25 fps [3] and the highest frame rate currently supported by the Philips Veradius Neo system is 23 fps [4].

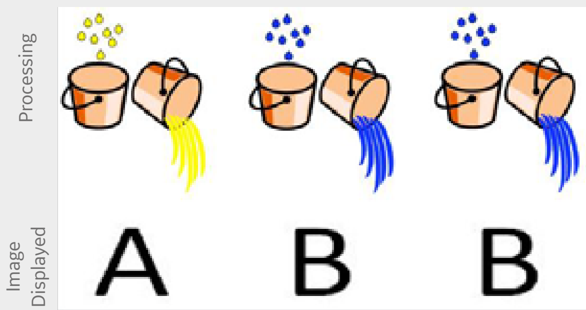


Fig.5: CMOS read/reset analogy. In the first frame, we see clear, unmixed yellow; in the second frame, clear, unmixed blue, and in the third frame, clear, unmixed blue. The letters below the buckets show a corresponding lag-free image.

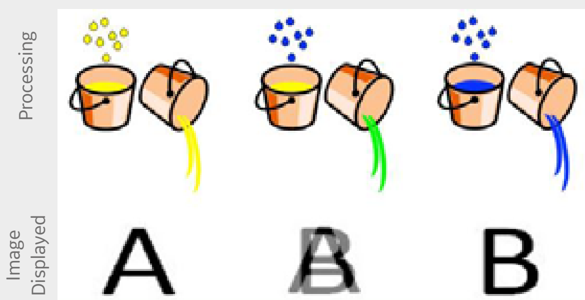


Fig.6: shows the a-Si analogy. In the first frame, we see clear, unmixed yellow, as we did in the CMOS example. However, in the second frame we see green—the lag of leftover yellow in the bucket mixing with the blue of the next frame, which isn't clear.

Solution

The crystalline structure of CMOS-based detectors allows greater electron mobility, which allows for much smaller and more complex pixels. The CMOS-based X-ray detectors use active pixel architecture, shown in Figure 4, rather than passive pixel architecture.

An active pixel consists of a photodiode, a charge amplifier, a row select gate, and a reset gate. The readout process of an active pixel is much faster than that of a passive pixel. Instead of recharging the photodiode, it simply senses the voltage at the output of the charge amplifier.

Since pixel reset and pixel readout are two separate actions in an active pixel, it is possible to reset all pixels at the same time after reading. This is very beneficial in the pulsed X-ray applications where the X-ray exposure and the readout must be completed within the time period limited by the frame rate.

The fast pixel readout and the fast pixel reset of CMOS not only avoids the image lag due to charging the R-C circuit, but also makes it possible to operate at a higher frame rate.

Think of pixels like the buckets shown in the following figures. The process of reading and resetting the detector for each image frame is akin to collecting and emptying buckets of paint. The X-ray photons are the paint and the detectors are the buckets. The reading process is analogous to collecting the paint in the bucket, and resetting so that reading can start again is analogous to emptying the bucket.

Figure 5 shows the CMOS analogy. In every frame, all the colored paint collected is also emptied with nothing left over inside the bucket—in other words, no lag is carried from a previous frame.

Figure 6 shows the a-Si analogy. Due to poor electron mobility, the detector cannot empty all of the paint at 30 fps, resulting in a mixing of all of the colors. This is represented in the ghosting/lag shown in the center frame.

Conclusion

Since the OEC Elite CFD can reset and readout the entire CMOS detector and process images in less than 33ms, there is no visible image lag at 30 fps. The superior electron mobility in the CMOS detector, which enables the use of active pixels, means that this technology can do what a-Si detector cannot—eliminate visible lag. □

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2. G. Zentai, "Comparison of CMOS and a-Si Flat Panel Imagers for X-ray Imaging," in IEEE International Conference on Imaging System Techniques, Penang, Malaysia, 2011.

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4. Philips Healthcare, "Philips Veradius mobile C-arm with Flat Detector specifications," Page 19.

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JB45448XX

OEC Elite CFD Flat Panel C-Arm

Observational study comparing the performance and usability of mobile C-arms

Eight radiology techs assisted on a surgical procedure of pedicle screw placement on GE OEC Elite CFD, *Brand A*'s system and *Brand B*'s system.

LARGER FIELD OF VIEW

Number of vertebrae captured on Antero Posterior image

GE 6.00	Brand A 5.25	Brand B 5.75

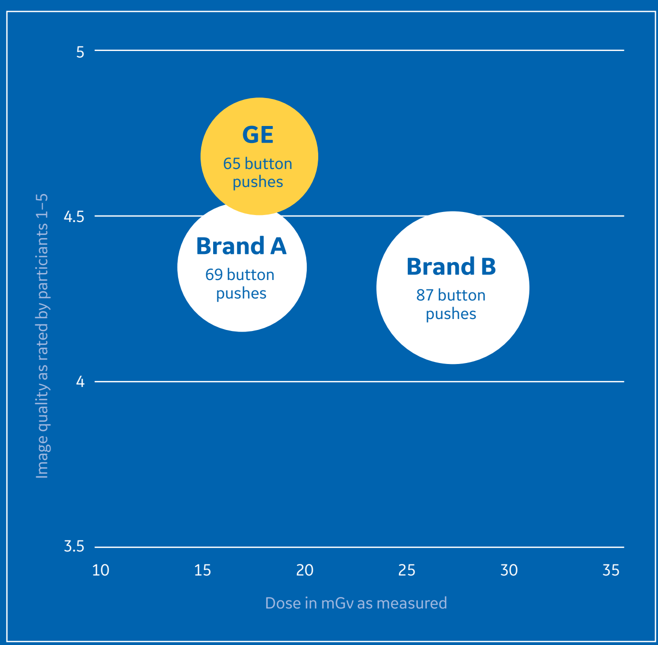
AT LOWER AVERAGE FLUOROTIME (MIN)

GE 0.78	Brand A 1.68	Brand B 1.14

...AND COMPARABLE NUMBER OF AVERAGE FLUOROSHOTS

GE 43	Brand A 41	Brand B 44

SUPERIOR IMAGE QUALITY



FAVORABLE RESPONSE ON SYSTEM USAGE

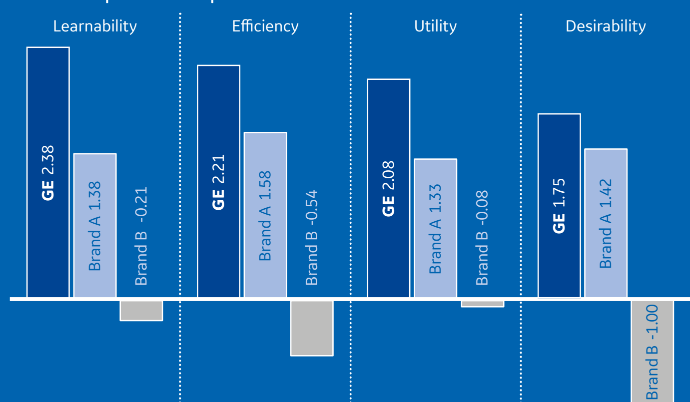
System usability survey average score

GE 87.8	Brand A 76.3	Brand B 43.4

Net promoter score

	Promoters	Passives	Detractors
GE 62.5%	62.5% promoters	37.5% passives	
Brand A -12.5%	25% promoters	37.5% passives	37.5% detractors
Brand B -87.5%		12.5% passives	87.5% detractors

User experience questionnaire score



LESS TIME TO POSITION

Time to set up

GE 49 sec	Brand A 52 sec	Brand B 73 sec

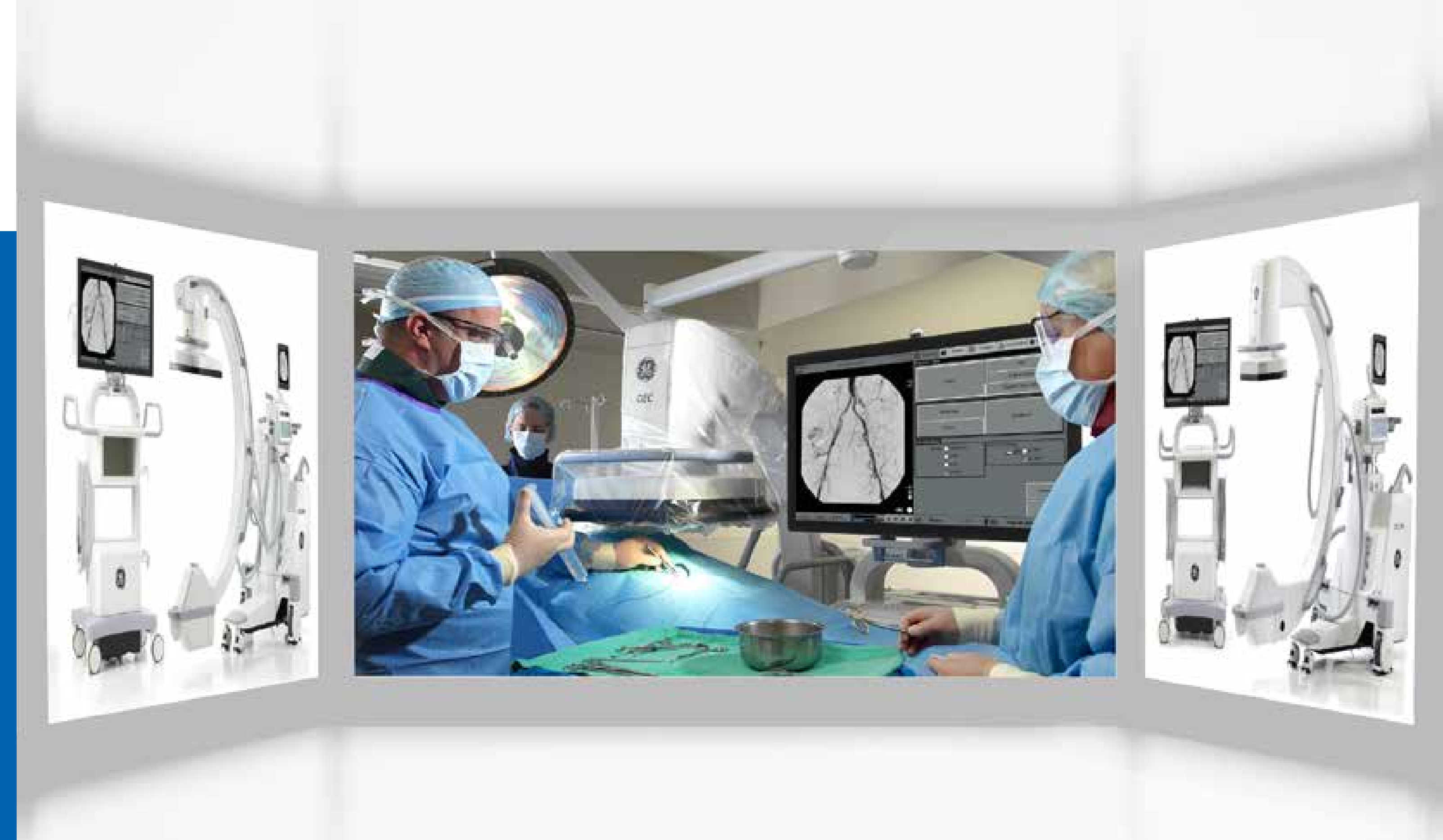
Time to finish initial AP image

GE 107 sec	Brand A 124 sec	Brand B 204 sec

This study was conducted by an independent third party Healthcare Research & Analytics (HRA) at DePuy's lab, Boston. Eight radiologic technologists assisted a surgeon to perform a spinal procedure in a cadaver lab on three systems: GE OEC Elite, Brand A's system and Brand B's system. Additional information about the study can be found in "OEC Elite performance and usability study observational study comparing OEC Elite and other mobile C-arms" available upon request from GE Healthcare.

SUS yields a single number representing a composite measure of the overall usability of the system being studied. Combined score is a well-established metric for assessing the usability of a product or system. NPS is obtained by asking a single question on a 0 to 10 rating scale. Based on the responses, users are categorized into one of the three groups, "Promoters" (9–10), "Passives" (7–8), and "Detractors" (0–6). UXS is a 12 question multidimensional subjective assessment designed to measure user experience. Usability is defined as the degree to which a product enables the most successful performance in the least amount of time; two usability dimensions assessed by the UXS are learnability and efficiency. Usefulness (utility) is defined as the product's potency relevant to the user's needs. Desirability is defined as the affective valence the user associates with the product after interaction.

JB64555XE



OEC Elite CFD

See beyond your expectations.

GE Healthcare's all new portfolio of OEC C-arms goes beyond what you expect of image quality, dose management, patient access, and performance in the OR.

www.gehealthcare.com/surgical_imaging

JB64469XE

Advanced fluoroscopy-endoscopy hybrid room for prompt diagnosis of lung tumors: an efficient solution

Experience of Dr. Stefan Barath at Skane University Hospital - Lund

The Interventional Oncology Lung department of Skane University Hospital - Lund, has built an innovative hybrid room solution.
The advanced endoscopy performed with high image quality fluoroscopy guidance, allows Dr. Barath to bring the biopsy tools towards the soft tissue tumor and to limit the iterative process of biopsy specimen collection. Right after extraction, each collected sample goes through cytological analysis for qualification.
The overall procedure performed in ambulatory patient conditions, ensures that the quality of the biopsy sample permits diagnosis and treatment planning during the procedure.
This solution has been put in place by the practitioners to answer to the healthcare guideline[1] limiting the delay of lung tumor diagnosis and treatment planning.

From a national initiative for optimizing care pathway for patients with lung cancer...

In 2017, the Swedish Ministry of Health in collaboration with regional cancer centers, issued a guideline[1] for the characterization of lung tumors.[1] The objective was and still is to decrease the time between reasonable suspicion of tumors to the initiation of treatment.

"From the first diagnostic X-ray to surgery, the delay shall not exceed 40 days: every day counts![1]
With the increasing number of patients screened by thoracic X-ray, as first examination for lung pathology diagnosis, the Interventional Oncology Lung Department at Skane University observed an increase in biopsy procedures over the past year of about 25%," noted Dr. Barath.

"The only way to accelerate the diagnostic investigation and define the treatment strategy for the lung tumor, is to have a fully-integrated hybrid room with both advanced endoscopy and high-quality fluoroscopy guidance, so cytology analysis can be performed within the same procedure."
Dr. Stefan Barath

The Interventional Lung Oncology department estimated its annual activity to be 1,800 endoscopic procedures including 750 EndoBronchial Ultrasounds (EBUS) for two practitioners. This successful activity contributed to the designation of the department as a reference center for Sweden.

...to a unique solution

In an effort to meet the national guideline, the Lund Thoracic Oncology department developed an innovative hybrid room dedicated to lung tumor investigation.

This highly technical room combines advanced endoscopy, including EBUS (Olympus) capability, as well as Electromagnetic Navigation Bronchoscopy ENB (SuperDimension™, Medtronic) with high quality fluoroscopy guidance (OEC Elite CFD, GE Healthcare).

High quality fluoroscopy guidance with flat panel detector mobile C-arm

"Biopsies are mostly performed in lung peripheral tumor tissues where higher toxicity recurrence is observed.

Beyond the first third of the lung, endobronchial probe guidance is performed under fluoroscopy.

The reduced diameter towards sub segmental bronchus - up to 1 mm (Fig. 1, Fig. 2 and Fig. 3) - and the complexity of the branching structure of the respiratory tracts requires high image resolution and contrast for the navigation guidance.

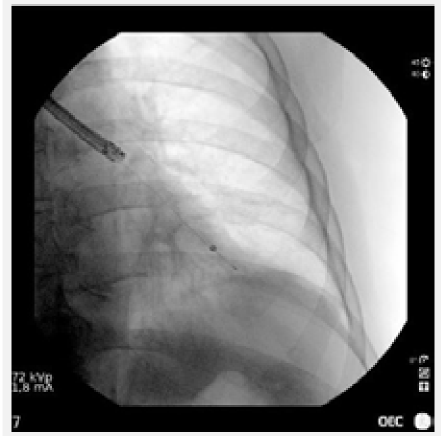


Fig.1 Cytology brush insertion in tumor for biopsy

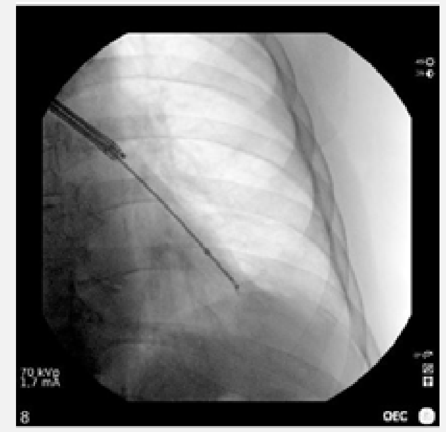


Fig.2 Biopsy forceps introduction in tumor

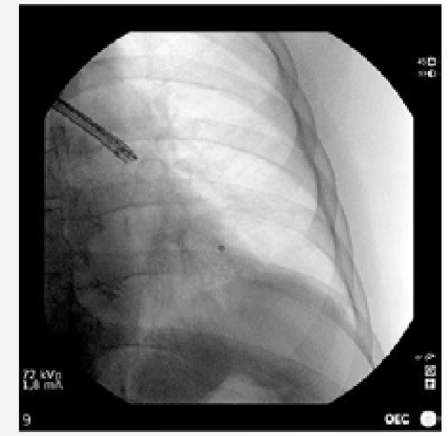


Fig.3 EBUS probe is introduced at suspected tumor level

In some complex endoscopic procedures EBUS can be used to accelerate the identification of the tumor, and to assist with the insertion of the brush within pathologic tissues. In this case, the image shows a non-homogenous echo.

The localization of the tumor can be improved with the use of the SuperDimension (Medtronic) navigation system. This Electromagnetic Navigation Bronchoscopy (ENB) system can help the practitioner to get better angles for biopsy," noted Dr. Barath.

"This new OEC Elite CFD Ergo C-arm is very easy to use for non-radiology staff. The user interface is simple. I unlock all the brakes, and then it is very easy to move from frontal to oblique views. I need high image quality with high resolution so I can see the characteristics of the tumors.

I need to see the borders of the tumor and their location. The OEC Elite CFD provides me with this high resolution image and large Field of View from the flat detector."
Dr. Stefan Barath

Once the tissue sample is removed, the cytology analysis is performed and shown immediately to the practioner. The team evaluates the quality of the sample extracted and the need to extract another one for the final histology analysis.

Dr. Barath might extract and analyse up to six samples within the same procedure.

A dedicated user interface has been designed by the hospital for the hybrid room to allow the endoscopist to select the source of image he wants to display on the monitors."

Dr. Stefan Barath, PhD., Interventional Lung Oncologist, was trained in Umea University Hospital in Respiratory Medicine and Allergy. He specialized in advanced endobronchial endoscopy techniques.

He has a PhD in Respiratory Medicine.

He is a consultant at Lund University Hospital for two years.

1. https://www.cancercentrum.se/globalassets/vara-uppdrag/kunskapsstyrning/varje-dag-raknas/informationsmaterial/everydaycounts_baspresentation_rev_vers_11sep15.pptx
Presentation Every Day Counts from Regionala cancercentrum I Samverkam

Focus on dose management in endovascular interventions

Experience with CMOS flat detector imaging.

Pr. Jonathan Sobocinski,
Vascular Surgeon, Hospital University Center Lille (France)

Introduction:

Pr Sobocinski is collaborating with GE Healthcare on a study to compare latest generation CMOS flat panel imaging with previous platforms. He has shared with us his first experiences with the OEC Elite CFD for the ongoing clinical work.

Can you describe the activity of Vascular Surgery in your hospital?

"The University Hospital of Lille is the biggest University Hospital in France with 2500 beds. My department of Vascular Surgery hosts 50 beds and 3 operating rooms. Two of them are equipped with mobile imaging systems, and the other one is a fixed room. We handle about 2000 arterial cases every year."

What are the main trends in your discipline?

"Endovascular surgery techniques have benefitted from several improvements over the last few years. For each patient, we tend to prefer a minimally invasive approach, whenever possible."

"We extended the volume of our activity opening a third operating room to be able to offer additional slots for endovascular treatment to aged patients with co-morbidities who couldn't undergo aggressive surgery. This also means that the use of X-rays is required, which is why the philosophy of my department is to perform each procedure using the least possible radiation exposure and contrast media as possible. We apply the ALARA ("As Low As Reasonably Achievable) principles and try to perform the procedure with the best compromise between radiation exposure, use of iodine contrast media, and surgery outcome."

How do you manage the increasing use of X-rays in your daily activities?

"We perform more than two-thirds of our procedures using X-rays. We know that both physicians and patients are exposed to a significant amount of X-rays throughout their lives, therefore we want to ensure that we perform procedures with the best compromise between X-ray exposure and image quality. We are very keen to find new interesting tools to reduce the radiation exposure without compromising on the best conditions for each procedure."

From your experience with the OEC mobile C-arms, what are the main contributors for endovascular procedure management?

"I think it is a very important point for the physician to keep a hand on the management of the entire procedure. The physician needs to control the X-ray exposure and also the tools that can help save some radiation dose. I am not able to run a procedure anymore without using a remote user interface because I want to manage the collimation blades, the image series, and the selection of images of the series I just made. Keeping a hand on the system during the whole procedure can have a real impact on saving some contrast media and radiation dose exposure."

Do you perceive any direct benefits for the patient using the OEC Elite CFD?

"There are several benefits of using the new flat panel detector system. For example lower radiation exposure and lower concentration of contrast media during injection. Now we only work with diluted contrast injections.

The workflow is quite easy to handle with the intuitive interface of the flat panel, allowing us to work more efficiently, reducing time spent in the operating room, which is always a positive aspect for the patient. General anesthesia and patient discomfort is automatically reduced."

What clinical benefits have you identified with the use of the motorization during a procedure?

"When we work on the hypogastric artery and we want to make sure that we will keep it open, we position the C-arm in an oblique projection. With the motorized version of the flat panel we can now save this projection angle so we can easily come back to this exact same position. We need to be at zero position for the exchange of material, but when we decide to inflate the balloon or deploy the stent we need to recall this projection to be sure that we will keep open the collateral of the artery we want to treat."

Why do you think the dynamic recording is an interesting fluoro mode during your procedure?

"Dynamic recording in standard pulse is a very helpful fluoro mode to create the map of the arterial system.

We set the cine acquisition at 15 frames per second, so I can recall easily the series with a very good resolution and just select the image I want to put on the reference monitor and use it as a mask afterwards, as a sort of fusion with the roadmap mode.

Images acquired can also be used afterwards to be recalled on the reference video monitor and help

Pr Jonathan Sobocinski:
"Live Zoom gives the perfect resolution with more precision of the challenging segment of the artery that we want to cross, stent, or visualize with less dose compared to magnification mode."

during the roadmap mode, to make sure that we will re-enter the artery just after the lesion and not too far in the healthy segment of the distal artery. It can provide a sort of mask fusion to make sure that we are in the right segment of the artery."

How do you manage when you need to zoom into detailed view?

"We are indeed big fans of the Live Zoom mode and big monitor display because both tools together alleviate the need to use magnification mode which increases dose. In general, Live Zoom gives the perfect resolution with more precision of the challenging segment of the artery that we want to cross, stent, or visualize with less dose compared to magnification mode.

Again, the idea is always to find the best compromise between image quality and radiation dose exposure."

What is your experience with measurement tools?

"During the intervention, under Live Zoom, we also have the possibility to measure the lesion, and also use the digital pen tool just to mark on the screen the exact position where we want to deploy a stent or inflate a balloon.

We can place marks on the screen, and it's quite easy to delete them. For example, the collateral I wanted to preserve, but I can also mark the lesion I want to treat. If I lose the roadmap, but still have the mark on the screen, I can use this landmark and avoid re-injection."

Is the measurement tool useful for a vascular procedure?

"The measurement tool is also helpful, in the sense that before we used a ruler under the thigh of the patient just to have an approximation of the length of the lesion, but the ruler is not on the same plane as the artery so we still had some uncertainty on the measurement of the lesion. Before placing a longer stent, with the flat panel this tool now gives us the possibility to know the length (for example, if I put a balloon is 20 mm long), we can use this tool to measure the distance I want to treat in the artery."

How does the Bolus Chase profile contribute to managing X-ray dose and image quality?

"The Bolus Chase profile is the perfect tool to make an acquisition of a very long lesion, especially when treating an occlusion of the SFA (Superficial Femoral Artery) or Popliteal Artery. With one acquisition, we can obtain a perfect map of the arterial system of the lower limb of the patient. It allows a massive reduction in the amount of contrast media because we just make one injection, and with the flat panel detector we can make a diluted injection of contrast media. We use half-half dilution and with this one single injection, one single acquisition, we have the whole artery.

Afterwards, we can select the one

image of interest from the series that we want to recall as a fusion mask and use it as a tool for the roadmap navigation. This way we can find where we want to go into the true lumen of the artery, and where we decide to put the stent.

So the Bolus Chase mode allows you to make only one acquisition of the whole leg and avoid making repeated injections of iodine contrast media and the Digital Subtracted Angiography (DSA) mode allows you to study the artery."

What about Digital Subtracted Angiography (DSA)?

"I am not a big fan of the DSA mode. I try to use it only for aortic cases because this mode provides subtracted image (without bony anatomy) and it's something helpful with obese patients, just to make sure that we are below the renal arteries, or if we want to see specifically the collaterals of the aorta.

For cases of lower limb treatment, I try to ignore this mode because I know that it increases the radiation dose. I try to work using the tools around standard fluoroscopy like the dynamic recording function in standard pulsed mode. It is just a regular fluoroscopy sequence that is recorded and replayed automatically. These sequences are done with small injections of iodine. We can recall an image from the series and avoid using the DSA mode."

Are there any specific studies you are working on at the moment?

"We are currently working on comparing the benefits of using a flat panel detector C-arm versus an image intensifier for patients with long lesions in the lower limbs. We work in vascular profile using 8 frames per second and the different tools around standard fluoroscopy.

We have previously worked with an OEC 9900, and we already noticed differences in terms of image quality, reduction of contrast media, and reduction of radiation dose for most of the patients. The flat panel seems to improve our practice, reduce X-ray dose and contrast media both for patients and physicians, according to our first results in our patient cohort."

Jonathan Sobocinski, MD, PhD., is Professor of vascular surgery and Head of the Department of Vascular Surgery at CHU of Lille (France). He was trained in Endovascular techniques during his fellowship with Pr. Stephan Haulon. He also spent a year as Senior Registrar at St George's Institute, London (UK).

Dr. Sobocinski is a paid consultant for GE Healthcare. The statements by Dr. 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. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.

JB63761XE

Infrarenal aortic aneurysm repair using a modular bifurcated stent graft

with an OEC Elite CFD

Courtesy of Pr. Sobocinski, Hospital University Center Lille (France)

Clinical challenge

Throughout the last decade, endovascular aortic repair has become a preferred surgical technique[1] to prevent the risk of aneurysmal rupture for eligible patients. Patient selection relies on strict anatomical criteria. The preoperative planning of the procedure includes careful analysis of the morphology of the aortic lesion and the access to the iliac artery. Only then is the feasibility and the stent graft sizing determined.
The procedure is then performed under fluoroscopy guidance. Depending on the complexity of the navigation (artery calcification, tortuosity, diameter) and patient thickness, the amount of X-ray radiation can be significant, and needs to be managed.

Solution

The procedure was performed with the assistance of X-ray imaging from an OEC Elite CFD C-arm, and an ImagiQ2™ (Stille AB, Solna Sweden) surgical table.
In order to limit radiation exposure, the fluoroscopy technique was set to 'low dose' with 8 pulses per second. Each fluoroscopy sequence was recorded and replayed at the speed of 8 images per second.
The recording and the replay of all the image sequences allows the physician to inject small amounts of contrast media to support the navigation of the tools, without using the Digital Subtraction Angiography (DSA) technique that is higher in X-ray dose. The contrast agent used was Xenetix® 300mg/dl (Guerbet, France), diluted by half over the whole procedure.

Clinical Example

An 88-year-old male presented an 80 mm diameter aortic infrarenal aneurysm. Patient was eligible for endovascular treatment and underwent an infrarenal aortic repair with a bifurcated modular aortic stent graft (Zenith Alpha™ Abdominal and Zenith® Spiral® -Z AAA Iliac Leg, Cook Medical Inc, USA).
Patient's BMI was about 30.9 kg/m2 (100 kg and 1.80 m).

Procedure

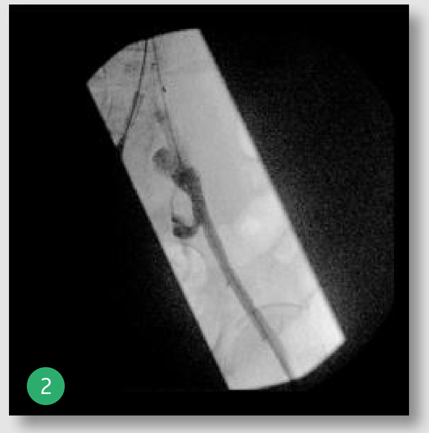
The procedure was performed under general anesthesia. Arterial access was gained percutaneously (ProGlide, Abbott Vascular, US) under ultrasound guidance. The preoperative planning assessed the best projection to optimize the visualization of the origin of the lowest renal artery. After introduction of the bifurcated body and before deployment, a short angiography with subtraction was completed with 7cc of contrast media. Then, the catheterization of the contralateral stump of the bifurcated body and the deployment of both iliac leg extensions were achieved while preserving the hypogastric origins. Final subtracted angiography with 12.5cc of contrast media, confirmed aneurysmal exclusion, renals, hypogastrics and stentgraft patency.
- The entire procedure lasted 40 minutes.
- The total fluoroscopy time used for the procedure was 1 min 56s.
- The total Dose Area Product (DAP) was 2.09 Gy.cm².
- The amount of contrast volume injected was 40ml.

Conclusion

The chosen fluoroscopy mode allowed the realization of an infrarenal aortic aneurysm repair procedure managing a low dose level of about 2 Gy.cm² for 2 min of fluoroscopy.

DSA & CINE FLUORO CONTROL IMAGES

DSA: intraoperative angiogram showing aneurysm sac at the aortic level.



Cine fluoro acquisition showing the origin of the left hypogastric artery.

Final DSA acquisition showing the good patency of the stent graft and good exclusion of the aneurysm.

X-RAY EXPOSURE TIME AND DOSE BY FLUOROSCOPY MODE

This summary shows that the Cine fluoro mode use allows significant savings in Dose Area Product (DAP).[2]

FLUOROSCOPY MODE	X-RAY EXPOSURE TIME IN THE MODE (seconds)	X-RAY EXPOSURE TIME IN THE MODE (%)	TOTAL DAP (Gy.cm²)
DIGITAL SUBTRACTION 8pps, low dose	1 & 3 : 5,6	4,8%	0,44
CINE FLUORO 8 pps, low dose	2 : 110,8	95,2%	1,65
TOTAL	**116,4**	**100%**	**2,09**

[1] Millemium Research 2011
[2] B. Maurel et al. 'Evaluation of Radiation during EVAR Performed on a Mobile C-arm '.European Journal of Vascular and Endovascular Surgery 43 (2012) 16e21.
Dr. Sobocinski is a paid consultant for GE Healthcare. The statements by Dr. 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. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.

Herniated lumbar disc: a full endoscopic transforaminal resection

Courstesy of Dr. Stefan Hellinger - Orthopedic surgeon, Spine surgeon, Consultant at ISAR Klinikum, Munich, Germany

Minimally invasive surgical techniques in spine surgery, such as percutaneous needle placement techniques or percutaneous fusions, have become an important part of the treatment offering.

Endoscopic surgical decompression is an option considered by patients fearing potential epidural scarring and perineural fibrosis that could lead to failed back surgery syndrome.

Such procedures require effective surgical equipment and high performance fluoroscopic technology.

Patient History

A 39 year old male was admitted for treatment with an uncontained disc herniation causing intervertebral lumbar pain radiating down to the left leg.

Conservative therapy performed since 2013 had delivered inconclusive results. The patient approached the hospital with a request for minimally invasive treatment, since he feared the potential consequences associated with epidural scar formation after open microsurgery.

The surgical technique chosen was decompression through partial discectomy via posterolateral endoscopy.

Upon admission, the patient complained of pain in the left leg up to VAS 7. The shooting pains would increase when he would bend or sit down, limiting daily activities.

At the time of admission, the patient presented a limp in his right leg. The spine showed a deviation to the right, induced by a muscle spasm. Reclination was up to 10°. Forward bending was reduced to 90cm (from fingertips to the floor). Laségue sign was 30° for the left leg and 60° for the right leg with crossing pain.

Pre-op MRI images in Sagittal and Axial planes showing an extruded disc at L4-L5, elevating nerve root and dura in inferior part of the foramen.

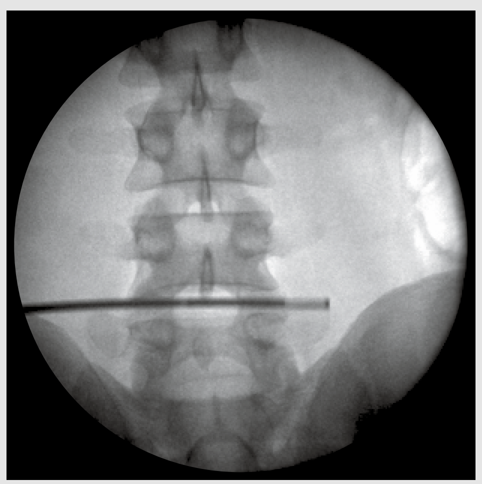
Case Report
Spine surgery

The surgical technique confirmed for this case was a transforaminal approach due to the location of the extruded disc material at L4-L5 in front of the intervertebral foramen.
In this case, this was the most efficient way to access the disc whilst minimizing trauma, avoiding a laminectomy going through the spinal channel from the dorsal access.

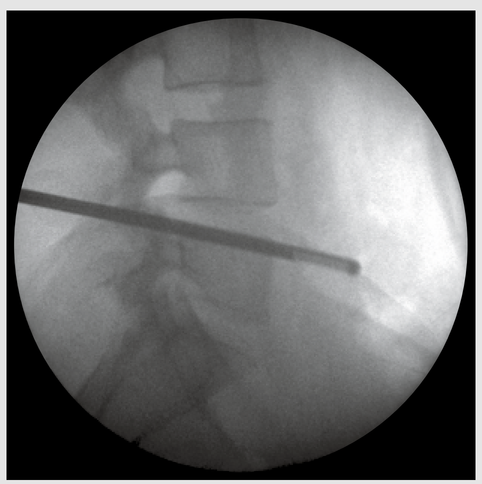
The MRI showed an extruded disc L4-L5 left lateral elevating nerve root and dura at the inferior foramen causing the muscle spasm.

The posterolateral approach to the foramen with a 6mm sheath was performed under fluoroscopy. Fluoroscopic guidance is necessary in particular for going directly to the lateral side of the disc hernia.

Images acquired with the OEC Fluorostar Compact C-arm. The incision level is identified using fluoroscopy, with antero posterior and lateral views obtained by positioning the C-arm to obtain squared vertebrae. A 5mm skin incision is made for the posterolateral access, which is identified with a mark drawn on the patient's skin based on the fluoroscopic images.

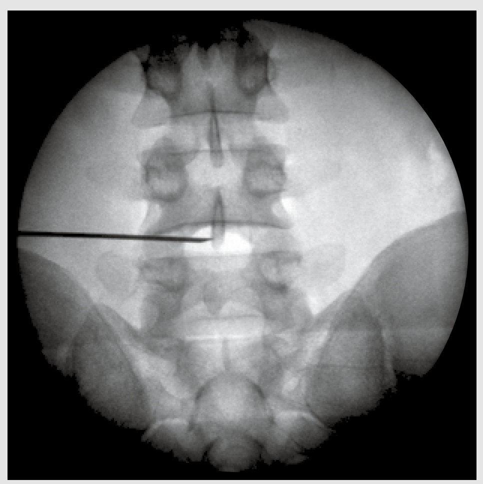


Antero Posterior (AP) fluoroscopy view of L4-L5.

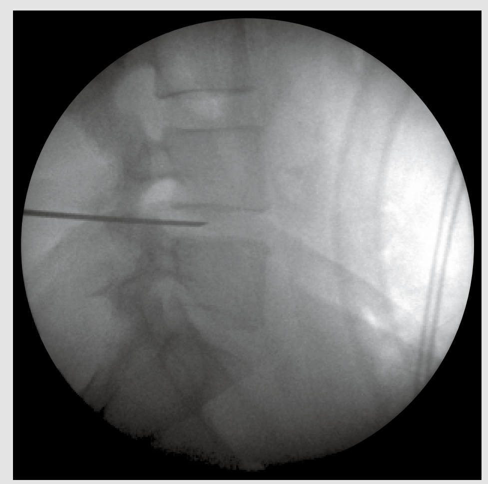


Lateral fluoroscopy view of L4-L5.

A puncture needle is inserted into the disc via the foramen, going over the superior articular process of the facet.

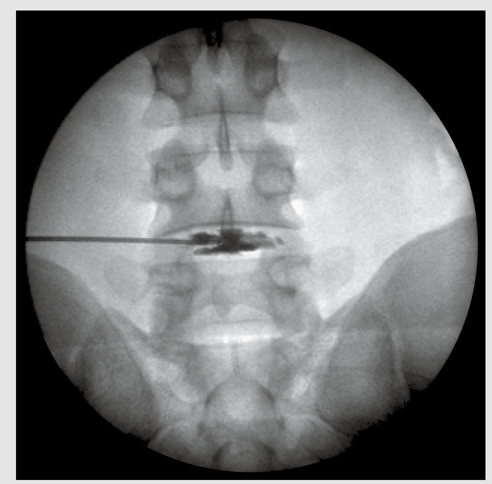


Antero Posterior fluoroscopy view of L4-L5.

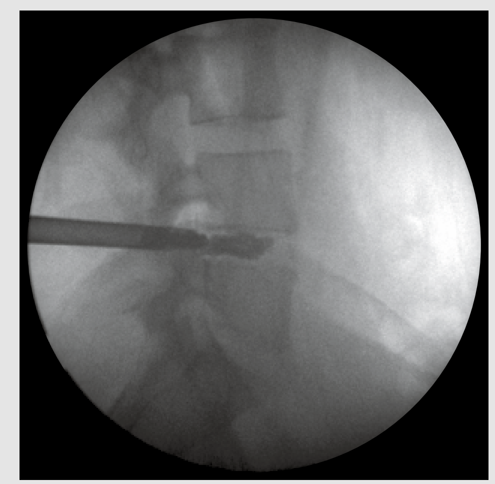


Lateral fluoroscopy view of L4-L5.

The endoscope cannula is introduced with fluoroscopic guidance and a special facet raspier is used to widen the extradiscal entrance. A discography is performed to verify the penetration of the tools inside the disc, marking the location of the extruded disc material and staining it with indigo carmine dye to guide the selective removal of disc material.



Antero Posterior fluoroscopy view.



Lateral fluoroscopy view of L4-L5.

Treatment

The patient was positioned for a conventional transforaminal approach, in prone position. In selected cases, lateral positioning is possible to facilitate the routing of the sheath from iliac crest to L4-L5. The procedure is performed under local anesthesia to control the patient's pain and to prevent damage to the root of the nerve, as done with neuromonitoring systems. It is an important factor for a fast recovery after the surgery.

Results

The sequestrated hernia was totally removed. The elevated nerve root and dura came into view fully decompressed. Bleeding was stopped by a special high radiofrequency probe.

Conclusion

The patient returned for a follow-up consultation and his pain was significantly reduced.

Resection of hernia with the endoscope

Final endoscopic verification.

Dr. Stefan Hellinger, Orthopedic surgeon, Spine surgeon, Consultant at ISAR Klinikum, Munich, Germany
After receiving training in orthopedic surgery from a pioneer in minimally invasive and endoscopic joint surgery, Dr. Hellinger applied the knowledge and skills that he acquired to spine surgery. Today, his daily work involves new procedures ranging from disc decompression to fusion, which helps him reduce procedure-related problems.

AP view of L4-L5.

AP view of L4-L5.

Extruding hernia stained with blue indigo carmine dye.

Extruding hernia resection final control

Images acquired with the OEC Fluorostar Compact C-arm

Dr. Hellinger was a paid consultant for GE Healthcare and was compensated for participation in this testimonial. The statements by Dr. Hellinger 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. hospital size, case mix, etc.. there can be no guarantee that other customers will achieve the same results.

JB46347XX

Point of view of a hand surgery specialist on image quality and radiation safety

Dr. Frederik Verstreken,
Hand surgeon, AZ Monica Hospital, Antwerp Belgium

How did you train to become a specialist hand and wrist surgeon?

"I am an orthopedic surgeon, following medical school at Leuven University, and further orthopedic training in Leuven, in Antwerp, and in Exeter, UK. I became fascinated by hand surgery and traveled to the United States for a hand surgery fellowship in the reknowned Kleinert Institute in Louisville, Kentucky, USA. At that time, it was without doubt the best place in the world to specialize in hand surgery.

Now, I perform about 30 hand surgeries per week. These surgeries can last from 15 min to 2 hours and longer. Hand surgery is a very diverse specialty, from easy short procedures, to very complex microsurgery cases. It is very different from a knee surgeon, for example, who does about 3 different types of procedures. Hand surgery covers a wider variety of procedures and, this is one of the things I like in my job."

What are the challenges of using fluoroscopy during surgery?

"I use fluoroscopy for about 20% to 30% of my hand surgery procedures. Imaging is very important, as it allows us to see inside the hand and evaluate bony deformity and correction. Exposure to radiation is something that surgeons have become increasingly worried about, more so than previously. During the surgery, our hands, thyroid and eyes are very close to the X-ray tube and we are very concerned about radiation protection.

Many surgeons prefer to lower the X-ray dose and exposure to radiation, even if that gives them a somewhat lower image quality. Equipment that combines excellent image quality with low radiation exposure is what we need."

How did the OEC MiniView C-arm change your specialty?

"The OEC MiniView is much easier to use during surgery than our previous imaging systems. In the past we selected a mini C-arm with the largest distance between the beam source and the detector to allow us to do surgery, without obstructing the working space too much. But the image quality was not as good compared to the OEC MiniView, and the mechanical properties were very poor. Every month we had something that needed to be repaired. The C-arm was drifting during procedures for example, which was very frustrating.

The OEC MiniView C-arm is compact, nurses have no difficulty bringing it into the OR, and once it is in position, it doesn't move. There is much less stress in the OR than before. OEC MiniView C-arm makes our procedures faster and at the end, we can achieve more and increase the workload. It gave us better image quality, the surgery takes less time, and it improves the quality of my surgical work. Nobody needs additional stress in the OR. And, in addition, the dose is very low with this C-Arm."

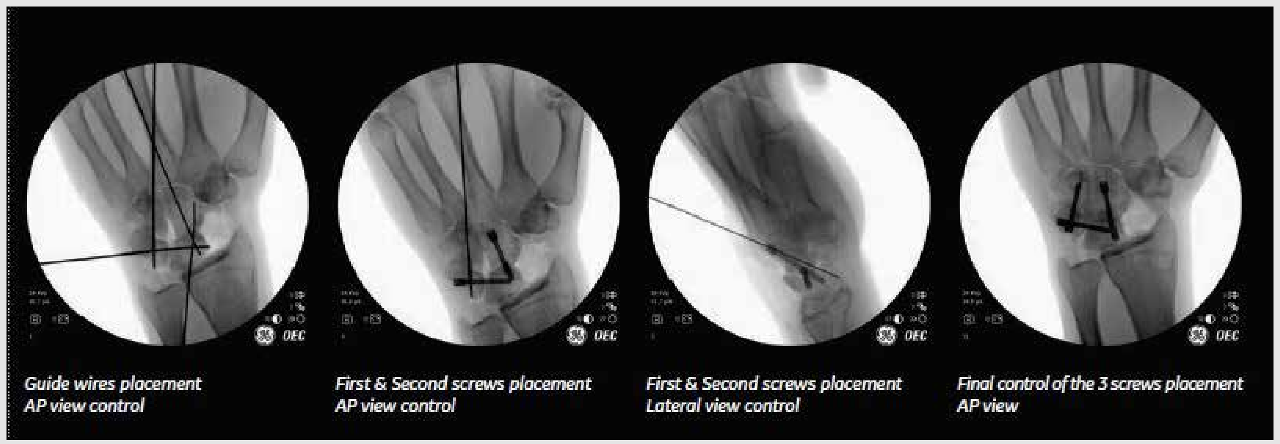
JB63762XE

How did OEC MiniView help you perform your procedures where fluoroscopy is needed?

“The most complex procedure where we need maximal detail and longer radiation time are arthroplasties of the PIP (Proximal InterPhalangeal) joint, complex finger fracture fixation, carpal fractures and more particularly scaphoid fracture reduction. These are very small bones, and we need details to be sure that we realign the bone fragments correctly. Finger fracture reduction has to be very, very precise. It is important to reduce the fracture with less than 1 mm of error. That’s why image quality is very important.

When we use arthroscopy in addition to fluoroscopy, the handling of the tools gets more complicated. I use arthroscopy for arthroscopic assisted fixation of scaphoid bone fractures for example. With the help of a small intra-articular camera, we realign the bony fragments, and at the same time use fluoroscopy. It is a lot of machinery, which results in a complex working space. But the OEC MiniView is very easy to handle which facilitates the procedure. And with the button on the system to lock and unlock the arm, it is very easy to shift the C-arm in and out of the operating field. I can easily remove the C-arm, do surgical work, bring it back and lock it to control again. It is very stable and very easy to maneuver.

OEC MiniView makes us feel more secure, we feel we can trust the image more than before. If you have to rely on poorer image quality, you can think the reduction and result are satisfactory, but when formal X-rays are made after the procedure, you may discover it is not the case. This does not happen with the OEC MiniView, we feel reassured and more satisfied once the procedure is finished, it takes away stress.”



Partial wrist arthrodesis under fluoroscopy guidance

Proximal InterPhalangeal (PIP) joint arthroplasty

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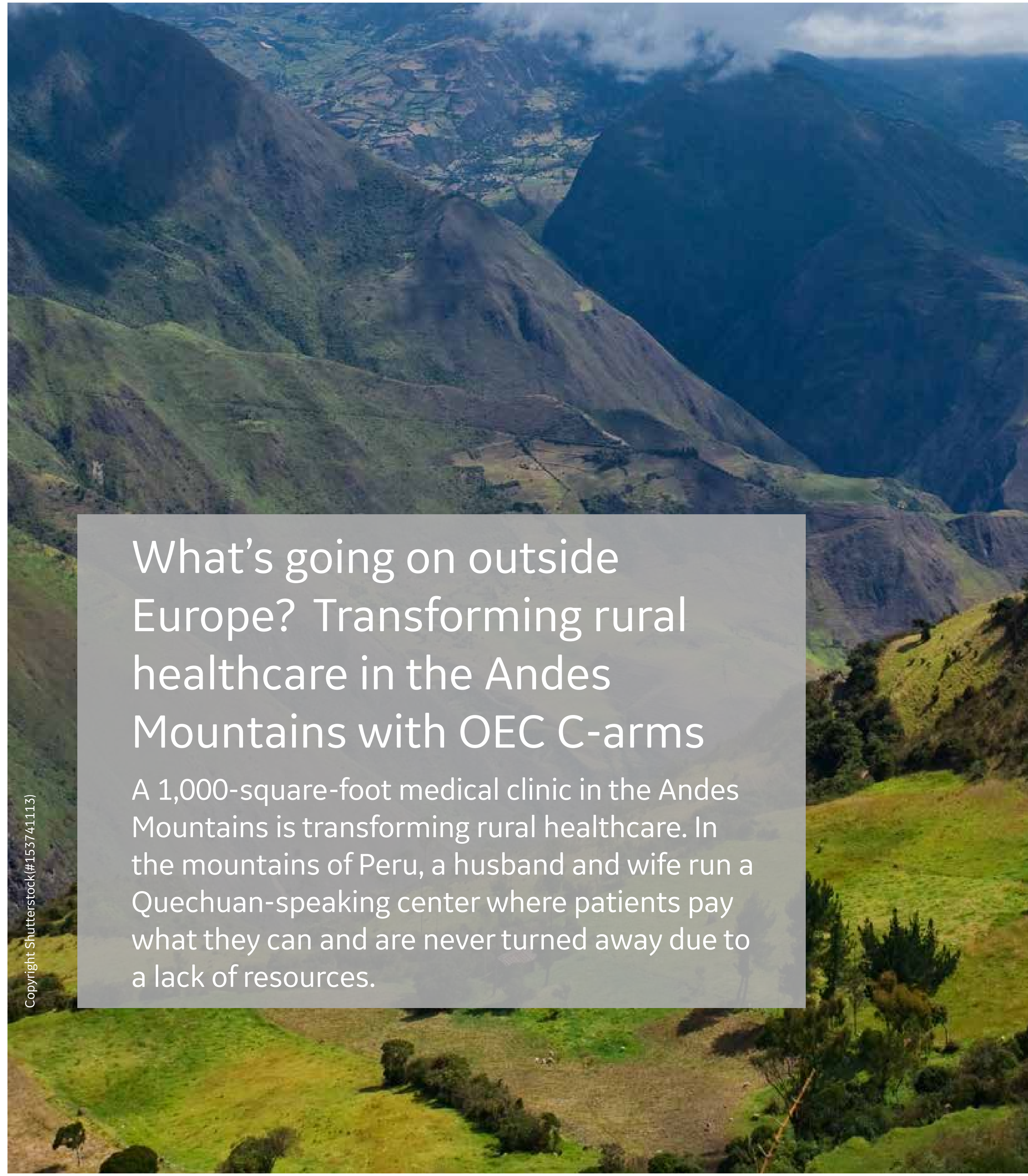

What’s going on outside Europe? Transforming rural healthcare in the Andes Mountains with OEC C-arms

A 1,000-square-foot medical clinic in the Andes Mountains is transforming rural healthcare. In the mountains of Peru, a husband and wife run a Quechuan-speaking center where patients pay what they can and are never turned away due to a lack of resources.

High in the sky between the peaks of Peru's Andes Mountains lies a picturesque 70-mile stretch of land called the Sacred Valley. Running between Cusco and Machu Picchu, this fertile valley was once highly prized by the Incas thanks to its rich soil and moderate climate.

Today the valley is still home to the Indigenous Quechua, a rural population that continues to subsist on agriculture. And while the area remains rich in crops and tradition – the Inca language, music, food, and handiwork thrive here – it lacks many modern amenities, including reliable electricity and medical care.

Location, poverty, and cultural differences are major barriers to healthcare access for the Quechuans. Previous studies have established that nearly 60% of the indigenous Peruvian communities do not have access to a healthcare facility.[1] Those that do often struggle communicating with healthcare providers, many of whom speak Spanish but not Quechua, an officially recognized language in Peru.[2]

Guido Del Prado was raised in Coya, a Sacred Valley province located an hour outside of Cusco. Growing up, he experienced the healthcare disparity firsthand.

"*In Peru, public healthcare should be focused on the vulnerable population.*" Guido explained. "*Unfortunately, the resources and budgets are being used to build centers, rather than increase the quality and personal care for patients that, oftentimes, are Quechuan speakers.*"

Guido left Peru to attend school in the United States, where he served as a Peace Corps Director and U.S. Foreign Service Officer. But after retiring in 2005, Guido and his wife Sandy – who once served as a member of the Peace Corps in the Sacred Valley – decided they wanted to address the healthcare challenges in Guido's hometown, so they returned to Coya and opened a medical clinic called Kausay Wasi, which is Quechuan for "House of Health." Their goal was to treat the Quechuan population and beyond with dignity and respect and provide high-quality, personalized healthcare using the best technology available.

The clinic, which is less than 1,000 square feet, has two operating rooms, a laboratory, a pharmacy, an X-ray room, six offices, a room for dental procedures, and, a block away, a physical therapy/rehabilitation unit that creates and fits orthopedic prostheses. Employees of the clinic speak Quechuan and patients pay what they can but are never turned away due to a lack of resources.

Kausay Wasi treats people of all ages with a variety of health problems, but very commonly sees pediatric patients with orthopedic conditions, like hip dysplasia. Without early treatment, these conditions can develop into a lifelong physical disability.

Because of this, Guido helped acquire an OEC Brivo, a mobile C-Arm from GE Healthcare, that uses real-time fluoroscopy (commonly known as X-Ray) to help physicians perform diagnostic exams and musculoskeletal procedures. While the Brivo enables physicians to perform trauma, spinal, urological, abdominal and general surgeries, as well as offer pain management, it is especially helpful during orthopedic procedures.

"*Before the Brivo, doctors would perform procedures as best as they could without real-time imaging – reorienting the bones and inserting the screws based on diagnostic images taken before the procedure.*" *Talía Vargas, Account Manager at GE Healthcare, explained.* "*But how could they know if everything was placed where it needed to be? They were working blindly and as a result, the surgeries took a long time and were more invasive because the doctors would have to make larger incisions.*"

Since the Brivo was installed in 2017, physicians can make real-time decisions based on the information gathered during surgery. As a result, Guido says there has been an uptick in patient load. "*Thanks to the OEC Brivo, the clinic has been able to see double the number of children we used to see before.*" Guido said.

One patient recently travelled to Kausay Wasi from Pucallpa, a city located in the Amazon jungle in Eastern Peru. She was born with a severe limb deformities that significantly impacted her mobility and quality of life. After undergoing

five different interventions using the Brivo, this patient has learned to walk, write and participate in activities her immobility once prevented.

Today, 13 years since Kausay Wasi opened its doors, the clinic has done more than just serve its local community. In recent months, individuals from Bolivia and Ecuador heard about the hospital and traveled to the Sacred Valley to be treated for their medical conditions. As Guido and Sandy look to the future, they hope to expand Kausay Wasi and continue to close the healthcare gap in Peru.

"*Our mission will continue to be providing attentive, high-quality healthcare while treating our patients with dignity and respect using the best technology available.*" Guido said. "*That is what they need.*"

1. https://www.amnesty.org/en/press-releases/2009/07/peru-unequal-access-health-services-costs-poor-and-indigenous-womene28099s-li/

2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1481610/

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.

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