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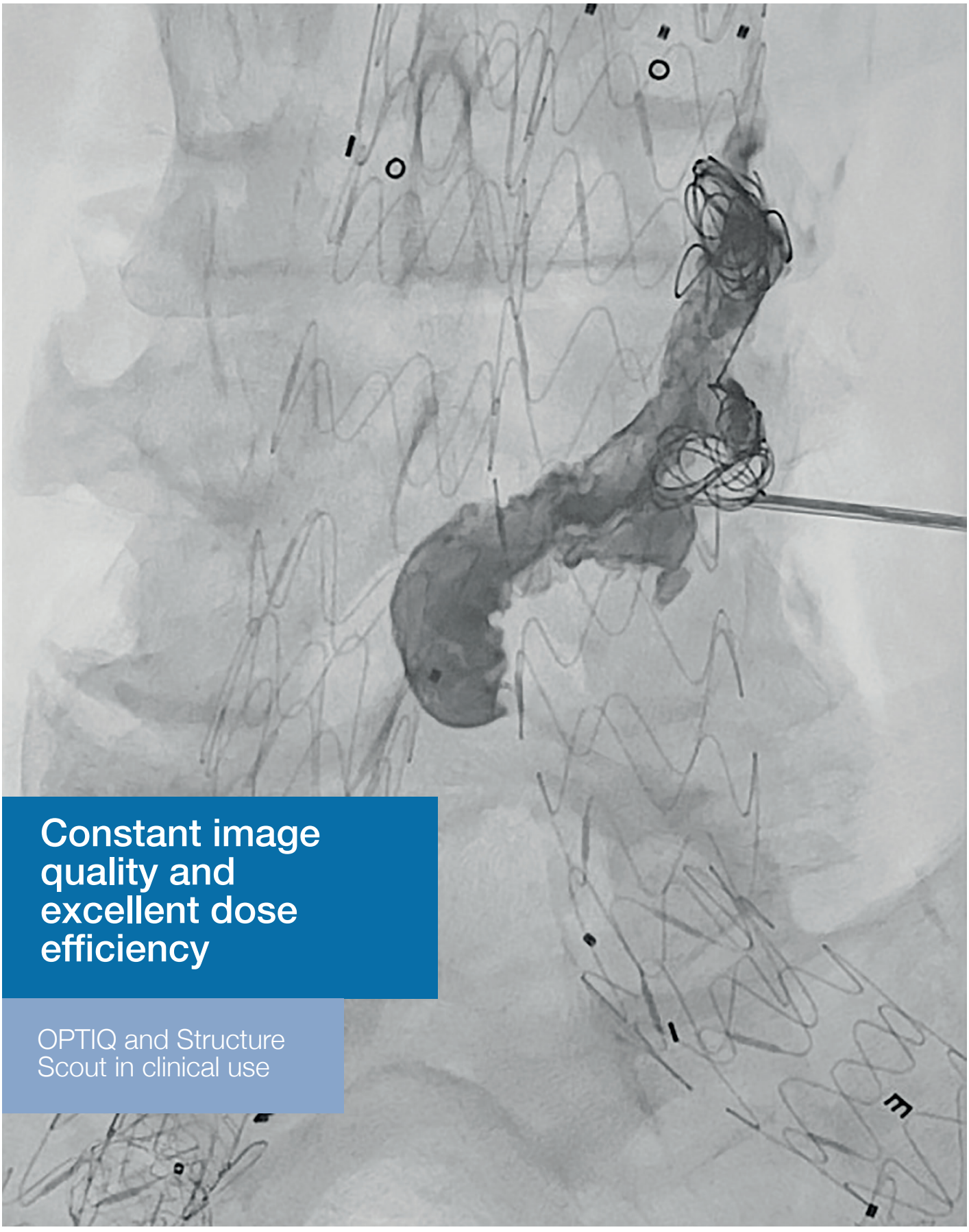


Constant image quality and excellent dose efficiency

OPTIQ and Structure Scout in clinical use

This educational supplement has been sponsored by Siemens Healthineers

IO offers “big and bright future” for the treatment of liver malignancies

During minimally invasive procedures it is of central importance that interventionalists have quality imaging to maintain precision and accuracy. Historically, however, difficulties have arisen when attempting to keep consistently high image quality (IQ) while reducing radiation dose to as low as reasonably achievable (ALARA). **Philippe Pereira** (SLK-Clinics GmbH, Heilbronn, Germany) believes that by combining technological innovations like OPTIQ with personalised, multidisciplinary oncological medicine, “we have a big and bright future”.

A FORERUNNER IN THE development of angiographic imaging and guidance software, Siemens Healthineers’ new ARTIS icono ceiling system, including the radiation exposure control OPTIQ, provides novel dose management while sustaining high-quality imaging. Pereira elaborates on how the ARTIS icono system has transformed their workflow and procedural success.

Last year, the ARTIS icono system was installed in Pereira’s radiology department, replacing the previous Artis zee system. “We were one of the first institutions to have these systems installed worldwide,” he says. “After a few days of training with the new ARTIS icono system, we were able to start comprehensive therapies for all patients—in the first month we had around 120 complex and challenging chemoembolization patients and we were able to continue our work without postponing appointments.”

Regularly performing interventional treatments for cancer patients, Pereira’s department follows “specific pathways” which have a strong multidisciplinary focus. “All cancer patients must first go through the interdisciplinary tumour board—that is a prerequisite not only for me, but for the surgeon, for the oncologist, for the pathologist,” he states. Pereira’s focus on interdepartmental teamwork when performing cancer treatment was a core message of his European Conference on Interventional Oncology (ECIO) presidential statement in 2022 and 2023. “Every cancer is personalised, so every treatment should be personalised to that cancer. We perform the complete spectrum of interventional oncology—percutaneous, arterial, and intra-arterial, in all of which we use the ARTIS icono system for palliative, symptomatic and curative treatment,” Pereira explains.

Philippe Pereira

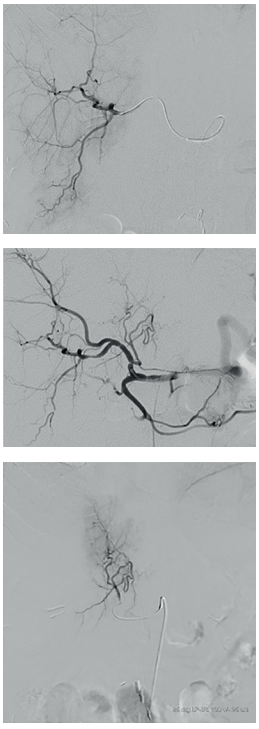
Pereira and his team often perform transarterial chemoembolization (TACE) procedures, alone or combined with systemic treatment. This can be selective or non-selective, he explains; “it depends if you treat primary or metastatic liver cancer. Mostly these patients will have systemic treatment in parallel with TACE or chemoperfusion while the latter takes two or three hours.” For TACE, high-quality imaging is required to find tumour-feeding arteries which must be embolized. “We need the perfect 2D imaging, which is what we have with the ARTIS icono ceiling system,” Pereira says. “You can recognise tiny arteries when treating, for example, hepatocellular carcinoma”.

With the ARTIS icono ceiling system, Pereira’s team can achieve high-quality 2D imaging at lowered radiation doses. This, he states, was “one of the biggest surprises” following a comparison of IQ and radiation dose between the ARTIS icono and previous system in approximately 80 patients. They found that dose was reduced by 50–80% with the new OPTIQ technology while they were able to maintain the same IQ. “It is fantastic to have this reduction of dose, not only for the patients but also for the team,” he notes, drawing focus to the added importance of dose reduction for female technicians of reproductive age and intent.

Siemens Healthineers’ newly developed OPTIQ exposure control technology also optimises radiation dose for each imaging situation. Using a self-adjusting algorithm which considers source-to-image distance (SID), collimation settings, grid status and patient thickness, the system checks up to 15,000 possible parameter combinations in real-time to select the most dose-efficient settings for the highest quality imaging.

With the new OPTIQ technology, Pereira’s workflow has improved, he states, because “you no longer need to click to change SID to optimise image quality and dose—for patients, if you do not have to move the machine during the procedure, they are much more comfortable and this improves the overall experience for us too, making everything a little bit faster.”

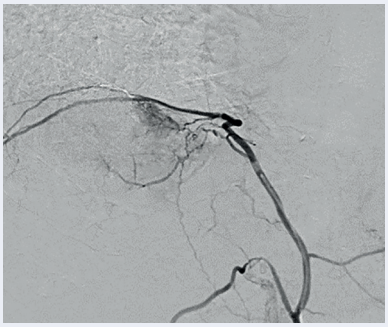
Reflecting on the importance of innovation within the field of interventional oncology and TACE, Pereira notes that the combination of a “good machine, image quality, standardisation, a multidisciplinary tumour board and interventional oncologist” is central to providing successful treatment. “Oncology is an area of medicine with the highest improvement, but unfortunately as populations age, more people will become cancer patients. No specialty alone has the solution for a cancer patient—not the surgeon, the oncologist, or the interventional radiologist.” Pereira imparts that by combining innovations like the OPTIQ technology with personalised, multidisciplinary oncological medicine, “we have a big and bright future”.



TACE procedure in multiple sessions to embolize liver metastases

Transarterial chemoembolization

In a 75 year old female patient with hepatocellular carcinoma



DSA with 2.4F catheter in phrenic artery (diameter <1mm). The feeders for the lesion are further branches of the phrenic artery, both tumor blush and the feeding arteries are well visible

Prof. Philippe L. Pereira, MD, SLK Clinics, Heilbronn, Germany

PAE and UAE: Promising minimally-invasive procedures gain efficacy with new precision image-guidance technology

In recent years, prostate artery embolization (PAE) and uterine artery embolization (UAE) have emerged as encouraging minimally-invasive options often deployed to treat benign prostate hyperplasia and myoma. To gain the essential anatomical knowledge needed in order to navigate and identify target arterial branches, high-quality imaging is paramount. Speaking to *Interventional News*, **Bernhard Gebauer** (Charité University Hospital, Berlin, Germany) expands on the "excellent effect" of the new ARTIS icono technology in helping to realise the potential benefits of these challenging procedures.

"WE ARE BECOMING LESS INVASIVE and are trying to be more selective," says Gebauer, to him the recent shift toward less invasive treatments like PAE and UAE when treating eligible patients requires "more sophisticated interventional radiologists—but also more sophisticated materials, smaller catheters, better imaging techniques and improved angiographic machines to carry out."

As the head of interventional radiology at Charité University Hospital, Gebauer has formed the foundations of their angiography suite's workflow when performing PAE or UAE, "typically beginning with a magnetic resonance imaging (MRI), as we then could evaluate the vascular anatomy of these patients before the procedure".

Gebauer adds that for males presenting for treatment, *syngo* DynaCT will typically be carried out "from the start, to have an idea where exactly the prostate artery is," whereas in younger females where radiation may affect fertility, alternative options are considered. To this end UAE is often carried out under 2D guidance only, to keep dose at its lowest level and define the best angulation for device navigation.

The conscientious steps Gebauer and his team take to monitor and protect against radiation are twofold—achieving dose reduction at no detriment to the overall success of the procedure, Gebauer states, is key "not only for the patients, but for staff also". "It is very important if you are involved in regular procedures. As a member of staff you are subject to a significant amount of radiation. We really try to take care, and with the ARTIS icono system we were positively surprised that we could reduce radiation dose considerably and still achieve good image quality—that is an excellent effect of the new Siemens Healthineers' system," Gebauer says.

Critically, the ARTIS icono system is able to draw from a vast database containing 300 million entries which allows for the selection of the most appropriate, dose-efficient parameters for each individual patient. For patients attending Gebauer's angiography clinic for PAE and UAE procedures, the ARTIS icono system provides their team "access to different fluoroscopy protocols that allow for lower radiation dose, but equally enable higher doses for better image quality depending on the severity of the intervention".

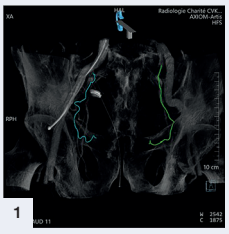
Bernhard Gebauer

In redefining the principles of automatic exposure control while providing consistent image quality independent of the source-to-image distance, interventionalists can now create some space between patient and machine, making it "much easier to communicate" with patients, Gebauer adds. For him, this update is essential—"If you have been practicing for 20–22 years, each time you must bring the detector as near to the patient as possible. Now however, with OPTIQ things are different." The new technology reaps "significant benefits to patients" both current and future, he says, providing enhanced comfort and state-of-the-art efficiency throughout complex procedures.

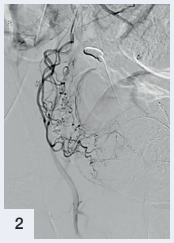
> **"With the ARTIS icono system we were positively surprised that we could reduce radiation dose considerably and still achieve good image quality."**

Prostatic artery embolization

In a 72 year old male patient with prostate hyperplasia



1. Bilateral prostatic arteries found on syngo DynaCT



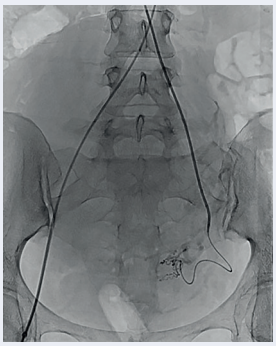
2. DSA of right prostatic artery before embolization

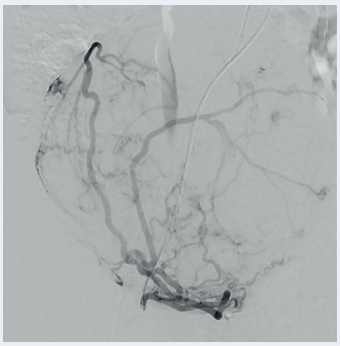
3. Single angiogram after right prostatic artery embolization

Uterine fibroid embolization

In a 35 year old female patient with myoma.

The whole procedure conducted with only 590µGym², with sufficient image quality even at ultra-low dose.





Prof. Bernhard Gebauer, MD, Charité University Hospital, Berlin, Germany

New OPTIQ radiation exposure control provides "huge step forward" in CO_2 angiography and new IR procedures

"This is a huge step forward," says **Maximilian de Bucourt** (Charité University Hospital, Berlin, Germany), diving into why reducing radiation dose while maintaining a high-quality, precise imaging workflow, is central to delivering optimal outcomes in a range of minimally invasive interventional radiology procedures.

DE BUCOURT AND HIS TEAM perform a wide variety of percutaneous and endovascular procedures day-to-day, such as "stent placements, aneurysm exclusions of visceral arteries, and also some new procedures like pulmonary artery embolism thrombectomy," he lists. Where necessary in each of these treatments, de Bucourt cites the "impressive" ARTIS icono system and its new OPTIQ image chain, expanding on its "exciting" applications, particularly in optimising peripheral procedures using CO_2.

"OPTIQ is a newly developed exposure control supported by self-adjusting algorithms that automatically consider source image distance (SID), patient thickness and detector dose to find the best suitable variable and combination, applying this information in real-time," says de Bucourt. "Also in 3D, we have been able to use dedicated radiation exposure minimisation protocols for different weight classes in patients, for 80 and 100kg, we still have sufficient image quality that helps us treat patients."

Adhering to the ALARA (as low as reasonably achievable) principle and with increasing patient attenuation, conventional detector dose regulation has led to lower image quality, even in patients who fall within the average thickness range. This has meant that often interventional radiologists will remain on low fluoroscopy settings

Maximilian de Bucourt

to maintain a reduced radiation dose, switching to higher-dose protocols for shorter periods when needed, for example during stent deployment. However, de Bucourt states that his team sought to examine the details of radiation flow in their angiography suite, "to provide real-life radiation dose data for the interventions that we perform".

To do so, de Bucourt and his team analysed chemoembolization procedures against the German regulatory recommendation which advises that 20,000µGym² be the upper limit in terms of radiation use. With the new ARTIS icono technology they found that transarterial chemoembolization (TACE) procedures could sometimes be performed using just about a few 100µGym². "This is fantastic," de Bucourt adds, noting how patients who "require repetitive treatment" could benefit most from OPTIQ's pioneering exposure control.

As the market grows and the plethora of devices expand, it is essential for interventional radiologists to be able to clearly visualise a variety of materials without increasing radiation dose to the patient. For de Bucourt, while working alongside colleagues within the industry they found they "were quite amazed with the processes we could perform," referencing the ARTIS icono CO_2 protocols that offer a dose saving of up to 44% in acquisitions while maintaining the same visibility.

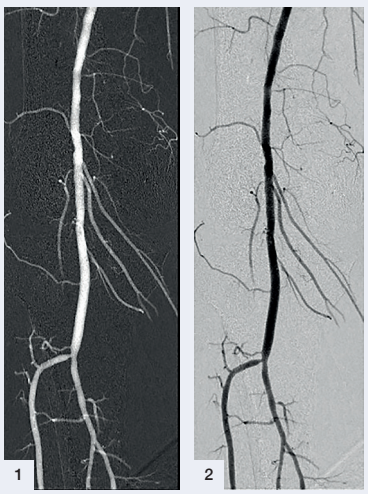
"With CO_2 angiographies, we have been able to maintain great image quality and relatively low dosages—sometimes we did not need iodine at all for the entire intervention, not only for diagnostic angiography but also for therapeutic interventions, including complex stent placements. We were able to solely rely on image data accumulated and acquired by CO_2 angiography," de Bucourt says, reporting on his experience with the ARTIS icono system.

Opening the door to innovation, de Bucourt and his team have found the new ARTIS icono system "easy to adapt" to the new technology, finding it "very convenient to integrate into almost every procedure that we perform—we have very good experience with the system and continue to generate good results".

Looking ahead, de Bucourt avers that "there is always room for integration with other advancements, and it is great to exchange ideas on how the holistic design of an angio lab will develop in the future. For now, at our institution, we have the first installed ARTIS icono ceiling system and that is a huge step forward for us."

Percutaneous vascular intervention

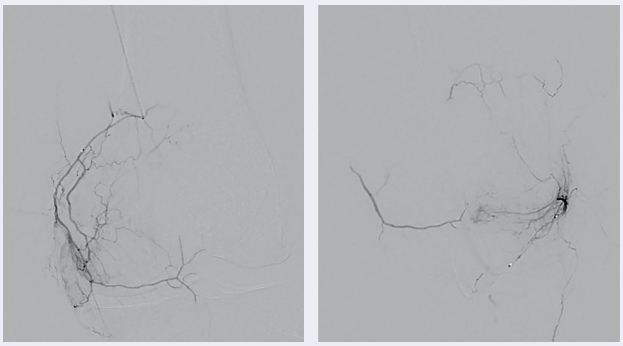
Lower limb intervention, using CO_2 as the contrast agent for the whole procedure. Image impression of popliteal artery and infrapopliteal trifurcation segments with depiction of genicular and petite arteries. DAP: ~0.55 µGym²/f



1. DSA using CO_2
2. DSA using CO_2 inverted

Genicular artery embolization

DSA with iodine before genicular artery embolization, performed by Julian Jenk and Janis Vahldiek (both Charité University Hospital) showing blush caused by synovialitis. DAP: 3.05–4.5 µGym²/f



Maximilian de Bucourt, MD, Charité University Hospital, Berlin, Germany

“Outstanding” potential for dose saving using material-specific imaging with OPTIQ imaging chain

As the first site to employ the ARTIS icono ceiling system ahead of market, **Bernhard Meyer** (Hanover Medical School, Hannover, Germany) shares his team’s “amazing” experience after transitioning to the new technology. Experienced in comprehensive interventional radiology procedures, Meyer expands on the “essential benefits” of material-specific imaging using Structure Scout**,** highlighting the “outstanding” potential it has in improving patient care.

“IT IS THE CONVENIENCE—TO have constant image quality through patients of differing sizes which enables you to focus on the procedure itself without needing to adjust the image protocol, keeping the imaging quality consistent,” Meyer says. He emphasised that understanding the “behaviour” of the system is crucial, and his team had “very few issues” when first using it. To this, he uses the example of collimation, which “with the conventional system, will increase the tube power and the patient dose to maintain constant detector dose, as the reduction of scatter radiation due to collimation is 'ignored'” he adds. However, with the ARTIS icono technology, Meyer emphasises its innovative imaging chain capabilities which take into account the changing levels of the scatter to consistently reduce dose. “This is the essential difference between the new and the previous systems,” he delineates.

Meyer—alongside his colleague Thomas Werncke (Hannover Medical School, Hannover, Germany)—has been involved in research carried out via phantom and animal investigations, to evaluate image quality and radiation dose reduction using the OPTIQ technology to produce patient-tailored high-quality image guidance. “The clinical use of the OPTIQ imaging was confirmed in the results of our experimental work,” Meyer states, noting however that they intend on conducting future experiments to “understand the full potential of using constant source-to-image distance (SID) with the system”.

Bernhard Meyer

Currently, when dealing with complex cases, Meyer expands on the “important” addition of Structure Scout (Siemens Healthineers), which optimises visibility of a range of materials based on their individual dose absorption during procedures. “Specific absorption of different materials is well-known,” he says, “so it was time to put this knowledge to use for material-specific imaging, especially liquid embolic containing tantalum and coils made from platinum—they really benefit from this approach.”

Meyer underlines the “high potential” for dose saving using the OPTIQ technology during lengthy procedures, when inserting multiple coils or several vials of liquid embolic. Importantly, these procedures frequently occur in younger patients he says, “so these dose saving techniques used in material-specific imaging are very important in my eyes”.

“The new OPTIQ imaging chain requires few user interactions only with the effect of following the as low as reasonably possible (ALARA) dose principle better,” Meyer explains. He notes that, as an addition to the technology’s ability to select the most suitable imaging parameters to save dose to the patient, “it would be great if artificial intelligence could provide support in selecting optimal protocols by detecting objects on the fluoroscopy, particularly in material-specific imaging”.

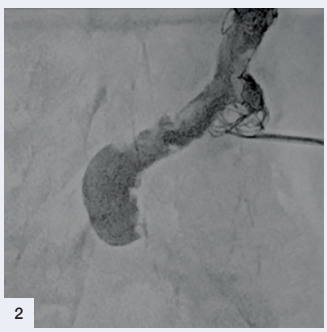
Meyer notes the educational possibilities the new ARTIS icono system offers and the opportunities it can provide to “consolidate knowledge and algorithms,” he says. “For young or less experienced interventional radiologists, this could be a great benefit to gain expert knowledge and develop key procedural solutions for the near future”.

> **“It was time to put the knowledge about specific material to use for imaging, especially liquid embolic containing tantalum and coils made from platinum—they really benefit from this approach.”**

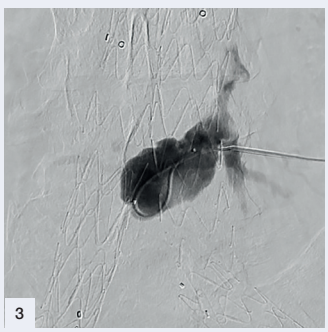
Endoleak treatment

68 years old male patient, endoleak type II after previous EVAR procedures

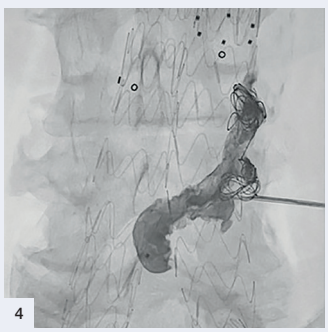
1. *syngo* DynaCT slab mode during needle progression



2. Fluoro protocol specified for Tantalum



3. DSA to confirm needle position



4. Body Device protocol after succeeded embolization

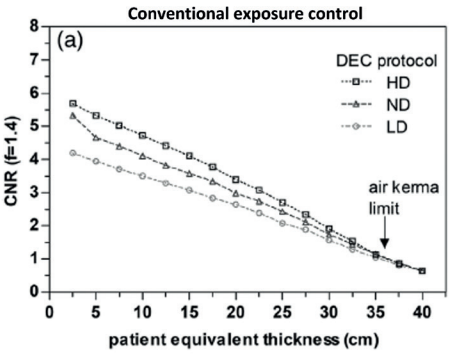
Prof. Bernhard Meyer, MD, Medical School, Hannover, Germany

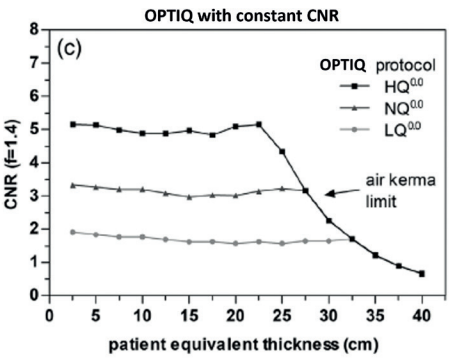
Data reveals “much lower” radiation dose and sustained image quality with novel dose regulation technology

Medical physicist and physician **Thomas Werncke** (Hanover Medical School, Hanover, Germany) speaks to *Interventional News* about his research into imaging quality (IQ), radiation dose reduction and material-specific imaging variables when using Siemens Heathineers' OPTIQ and Structure Scout technology. Among the benefits of using the system, Werncke conveys how its adaptive contrast-to-noise ratio (CNR)-driven exposure control using OPTIQ, is the “first” to allow users to specify image quality (IQ) preferences based on patient characteristics. Using OPTIQ’s predefined IQ protocols, interventionalists gain the advantage of intuitive exposure control while maintaining constant high-quality image guidance.

WERNCKE *ET AL*’S FIRST PHANTOM study sought to verify whether OPTIQ can maintain target CNR when performing angiography compared to conventional detector-dose-driven exposure control (DEC). Secondary to this, the authors estimated that the difference between incident air kerma—the measure for radiation dose—produced by OPTIQ and DEC respectively, when both exposure controls reach equivalent CNR.

Their findings showed that when using DEC, CNR reduced continuously with increasing attenuation, whereas OPTIQ, within physical limits, maintained a predefined CNR level *(see figures below)*. The mean estimated dose of OPTIQ compared to DEC was up to 40% lower in fluoroscopy, and up to 55% lower in digital radiography while maintaining CNR.





“Our first step was to show that you can define image quality, and we showed you can,” Werncke says of their results; continuing, he states “the second step was to investigate whether you can reduce radiation dose to the patient while maintaining comparable image quality. We investigated several parameters and we found that image quality was comparable for OPTIQ and DEC, while radiation dose was much lower with the new ARTIS icono system,” Werncke adds.

Building on their findings, Werncke *et al* conducted a second phantom study analysing the impact of material-specific imaging when using OPTIQ and Structure Scout compared to that with DEC, on radiation exposure. “The conventional approach does not take into account material-specific changes,” Werncke says, which led the investigators to create a three-dimensional (3D) phantom containing iron, tantalum and platinum foils and cavities filled with iodine, barium and carbon dioxide, developed to measure the CNR. Fluoroscopy and digital radiography were then conducted for each material.

“We found that material-specific image quality was variable for the conventional exposure control as expected,” he states, though OPTIQ provided predictable CNR. "Structure Scout can achieve similar image quality/CNR at lower dose," Werncke says, opening a "new dimension in imaging" with its "ability to define image quality and save dose to the patient using material-specific features for iodine, tantalum and platin".

This secondary phantom study revealed the substantial effect of imaging materials with higher K-edges, which can be beneficial in long-lasting embolization procedures. For example, with tantalum-based embolization material for “younger patients, treatment of the brain, the abdominal region or due to physical specificity,” Werncke explains. Developing this finding, Werncke and his team conducted an animal study comparing fluoroscopic IQ and radiation dose using OPTIQ’s tantalum (Ta)- specific protocol and DEC when performing abdominal angiography.

Of their results, the researchers found that, compared to DEC, OPTIQ “significantly improved fluoroscopic depiction of tantalum, while maintaining the dose”. They reported that, alternatively, dose can be considerably reduced by using OPTIQ, while also maintaining equivalent IQ.

Thomas Werncke

“Our findings could influence two things; First, fluoroscopy, which is of central importance in interventional radiology to monitor your handling, work with guidewires and so on. In this sense, our results mean we could define the image quality we would like to achieve and render this constant,” Werncke expands.

“Secondly, especially if you perform embolization procedures with tantalum, you can dramatically reduce radiation dose for patients. Embolization procedures normally take a considerable amount of time as you must inject embolics, wait, and look to see what is happening in the patient.”

Werncke and his team underline how OPTIQ's material-specific imaging has significantly improved procedural ease: “With the ability to define image quality, you can now think more about what you want to image, if you want to save dose, or what material you would like to utilise. With the number of imaging options the ARTIS icono system provides, you can ask ‘How can I image most effectively?’ and adjust accordingly to the ALARA principle.”

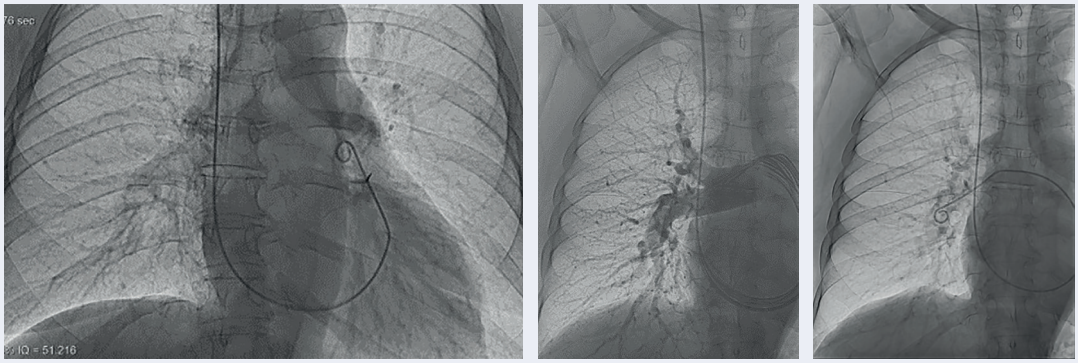
References

1. Werncke T, Kemling M, Tashenov S, *et al*. Comparison of a contrast-to-noise ratio-driven exposure control and a regular detector dose-driven exposure control in abdominal imaging in a clinical angiography system. Med Phys. 2021;48(12):7641-7656. doi:10.1002/mp.15288
2. Werncke T, Kemling M, Tashenov S, *et al*. Impact of a contrast-to-noise ratio driven and material specific exposure control on image quality and radiation exposure in angiography. Phys Med Biol. 2021;66(6):065020. Published 2021 Mar 12. doi:10.1088/1361-6560/abe83a
3. Werncke T, Meine TC, Hinrichs JB, *et al*. Tantalum-specific contrast-to-noise ratio or conventional detector dose-driven exposure control in angiography: radiation dose and image quality evaluation in a porcine model. Eur Radiol Exp. 2022;6(1):24. Published 2022 May 17. doi:10.1186/s41747-022-00275-z

Constant image quality and excellent dose efficiency – QPTIQ and Structure Scout in clinical use

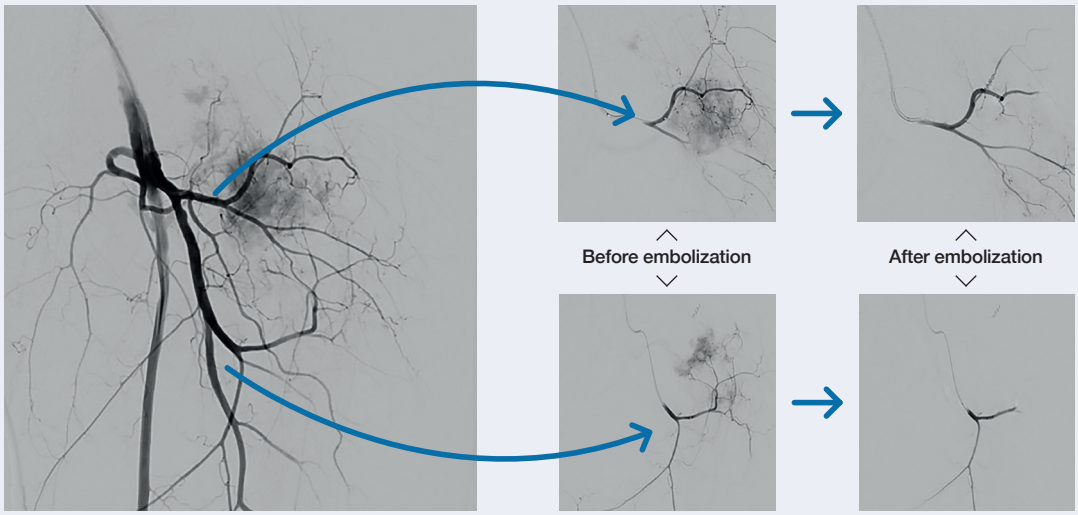
Pulmonal vessels

DSA with 2k imaging – native displayed



Prof. Bernhard Meyer, MD, Hannover Medical School, Hannover, Germany

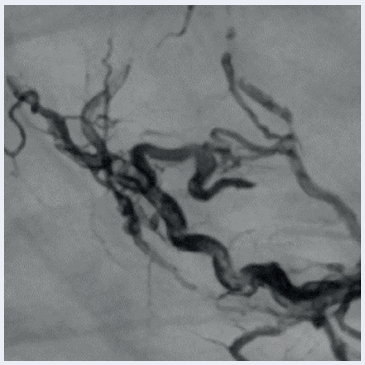
Peripheral tumor embolization



Prof. Bernhard Gebauer, MD, Dirk Schnapauff, MD, Charité University Hospital, Berlin, Germany

AVM treatment using material containing tantalum

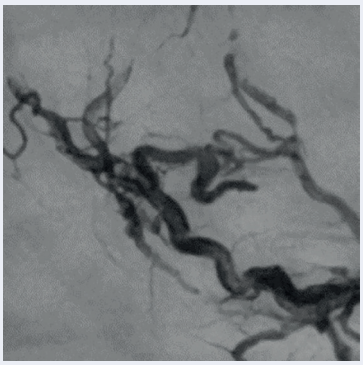
Structure Scout – optimised visibility of details and devices



Without Structure Scout:
DAP: 0.15 µGym²/f

82% less dose at same device visibility

Or invest in better image quality



With Structure Scout:
DAP: 0.026 µGym²/f

Prof. Bernhard Meyer, MD, Hanover Medical School, Hanover, Germany

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OPTIQ and Structure Scout

A new approach to image quality and dose

Based on big data, OPTIQ delivers constant image quality throughout a procedure, independent of angulation or patient size, while also significantly reducing dose. Structure Scout automatically optimizes the visibility of different devices and materials, based on their individual dose absorption property. This material-specific imaging is based on preset values. As a result, the system automatically adapts its exposure control parameters to the material used. Find out more how it supports you in expanding precision medicine.

ARTIS icono ceiling

OPTIQ:

ARTIS icono:

ARTIS pheno:

ARTIS icono floor

ARTIS icono biplane

ARTIS pheno

The products/features (mentioned herein) are not commercially available in all countries.Their future availability cannot be guaranteed.

SIEMENS Healthineers