

Clinical Advantages of NAEOTOM Alpha and ARTIS icono for Neurovascular Disease

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Meeting summary

This article is based on a presentation delivered during an Industry Symposium held as part of the 15th Congress of the European Society of Minimally Invasive Neurological Therapy (ESMINT). The Industry Symposium was sponsored by Siemens Healthineers, and took place on 6th September 2023 in Marseille, France. Dr Johan Wasselius, Head of Interventional Neuroradiology at Skåne University Hospital & Lund University, presented 'Clinical Advantages of NAEOTOM Alpha and ARTIS icono for Neurovascular Disease.'

KEYWORDS: ARTIS ICONO, COMPUTED TOMOGRAPHY (CT) IMAGING, DIAGNOSIS, NAEOTOM ALPHA, NEUROVASCULAR DISEASE, PHOTON COUNTING CT IMAGING.

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Background

The accurate detection and diagnosis of neurovascular disease,¹ such as arteriovenous malformations (AVMs), aneurysm and stroke, is essential to define prognosis and appropriate treatments. This requires high-resolution imaging to guide clinical decision-making and to determine the requirement for neurointervention strategies. The detection and diagnosis of neurovascular diseases and associated pathologies are usually carried out using computed tomography (CT) and computed tomography angiography (CTA). However, the accurate detection of pathologies can be affected by the presence of image artefacts, particularly where bony structures such as the skull base can impact accuracy. In addition, precision is difficult to achieve where the affected blood vessels are very

small or complex in structure. Improved imaging is particularly relevant where minimally-invasive neurointerventional disease management is preferred. High-resolution imaging is therefore important to diagnose neuropathology, and to determine features that will influence treatment decisions.

In summary, the detection and accurate diagnosis of neurovascular diseases requires improvement in the image quality and spatial resolution. Rapid, non-invasive, high-resolution image acquisition and analysis will enable the planning of procedures and make clinical decisions on treatments more effective.

An Overview of the NAEOTOM Alpha and ARTIS icono Technology

Although CT and conventional angiography techniques are indispensable tools, improved resolution is required for accurate diagnosis of disease, including diagnosis of neurovascular abnormalities. Increased image clarity can be obtained with new diagnostic imaging systems that use photon-counting detectors.² Unlike conventional CT scanners that use energy-integrating detectors to measure the total energy from several X-ray energies at once, the NAEOTOM Alpha imaging system³ uses photon-counting detectors to measure individual photons (proportional to X-ray energy) that pass through a patient's body and converts them into direct energy information. The smaller detector pixels and elimination of electronic noise in photon-counting detectors benefit patients since it allows lower radiation doses and reduced doses of iodine-based contrast medium. The obtained images have unparalleled clarity. This clarity offers a range of benefits, including the capacity to evaluate very small lesions and anatomical structures, including perforating arteries previously not visible on CTA. There are no artefacts from bony structures enabling a clear view of the vascular pathology. A major benefit is more accurate diagnosis and precise clinical decisions.

The ARTIS icono biplane⁴ is an interventional angiography system with state-of-the-art technology which offers high-resolution imaging. The system includes novel acquisition geometries focused on minimizing artefacts such as those commonly observed due to the large bony structures at the level of the skull base. In addition, high-resolution imaging of complex vessel anatomy enables confident clinical decision-making and treatment planning. The ARTIS icono provides the option of performing fusion imaging whereby angiography images can be overlaid with live fluoroscopy images enabling temporal deconvolution of complex vessel malformations. The ARTIS icono was shown to simplify the workflow in neurovascular interventions,⁵ and to improve the management of complex neurovascular pathologies.

Clinical Advantages of NAEOTOM Alpha and ARTIS icono

Dr Wasselius described the experience at Skåne University Hospital & Lund University of these two state-of-the-art systems for imaging vascular malformations and detecting

vascular pathologies. The NAEOTOM Alpha was relatively new to the interventional neuroradiology department but had enabled a step change in the visualization of neuropathology with high definition of even the smallest of vessels. For example, in a patient with a temporal AVM the high resolution of the NAEOTOM Alpha enabled visualization of small vessel pathology including a feeder aneurysm in high detail, venous ectasia and identification of the take-off of the ophthalmic artery, which cannot usually be seen with conventional CT. In addition, perforating arteries from the basilar artery was observed; this would previously have been very difficult to image by any non-invasive imaging modality. Diagnosing vascular pathology is also enhanced, for example, accurate discrimination of an aneurysm from a tortuosity of the posterior inferior cerebellar artery. Importantly, these images present virtually no artefacts. In particular, areas close to the skull base could be very clearly visualized. Furthermore, the capability to observe very small vessels at high resolution in the absence of artefacts means that vascular pathologies effectively 'have nowhere to hide'.

The high resolution with the NAEOTOM Alpha means that the image quality is comparable to conventional angiography. This facilitates clear planning of follow-on procedures and treatment regimens for each patient, e.g., selecting patients with aneurysms for clipping or endovascular repair surgery.

The images can rule out pathology, reducing the requirement for further invasive interventions where these are not required, or contra-indicated. For example, being able to determine that a suspected blister aneurysm was, in fact, not an aneurysm but a vein in close proximity to an artery, removed the necessity for further conventional angiographic intervention in one clinical case that was discussed during the presentation.

The ARTIS icono biplane was also described to be highly advantageous for accurate detection and diagnosis of vascular pathologies. This rapid, user-friendly system had been utilized for some time by Dr Wasselius and colleagues to identify a range of vascular pathologies using the high-quality images. A major advantage of this system is the spatial alignment which enables very fast and exact movement of the system, and the use of fusion imaging⁶ whereby CT images are integrated with live fluoroscopy images. The fusion process is carried out on frontal and lateral images and takes only a few seconds. It is

regularly used for thrombectomy cases. Fusion allows accurate navigation, e.g., identifying the position of a proximal basilar artery occlusion. In a case where there was stenting of the middle cerebral artery where the distal landing zone of the stent could be accurately seen using fusion. There are also significant improvements to cone-beam CT image quality. Imaging with the ARTIS icono directly after thrombectomy gives a good prognostic indication of what will be the longer-term likelihood of infarction. The excellent intra-arterial and intravenous contrast image quality can also mean that follow up of patients who have had stents or flow diverters placed can be performed in an entirely non-invasive manner. Finally, the temporal resolution of 3D images allows real-time detangling of complex vascular malformation, enabling clinical decisions to be made in a timely manner.

Summary

In conclusion, the NAEOTOM Alpha has exceptionally high resolution, enabling accurate identification of vascular pathology without artefacts. Using the proprioception of the ARTIS icono biplane allows faster and more exact navigation within the tissue and the use of fusion imaging enables extremely accurate detection, diagnosis, and monitoring of vascular pathology. Taken together, these new imaging tools have the capability to significantly impact neuroradiology and the diagnosis and treatment of vascular disease.

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