

# Remove Metal Artifacts to See the Unseen Supported by *syngo DynaCT SMART*\*

## *syngo DynaCT*

*syngo DynaCT* is a 3D-angiography technique often used in neuro-interventional cases to visualize complex vascular structures before treatment and to give the physician guidance during the procedure. *syngo DynaCT* can also provide contrast-enhanced follow-up images in the angiography suite, either immediately after the procedure or during a follow-up examination. Following the placement of a flow diverter, for example, it can give valuable detail about potential issues such as in-stent restenosis or bleedings. However, *syngo DynaCT* has had limited application in assessing patients after aneurysm coiling or clipping procedures as these metal masses cause disruptive image artifacts.

*“With syngo DynaCT SMART the metal artifacts are removed and the image quality of the DynaCT is improved a lot.”*

*“syngo DynaCT SMART is a big improvement in everyday life for a Neuroradiologist, and it increases safety and confidence of the procedure.”*

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**Professor Martin Skalej, MD,**  
Department of Neuroradiology, University Hospital Magdeburg,  
Germany

*“Intravenous DynaCT with syngo DynaCT SMART is our method of choice over conventional CTA or MRA to follow-up aneurysm patients after clipping and stent/ coil treatment.”*

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Chicago, USA

[1] E. Meyer, R. Raupach, M. Lell, B. Schmidt, M. Kachelrieß, “Normalized metal artifact reduction (NMAR) in computed tomography”, *Med. Phys.* 37 (10), October 2010.

[2] Psychogios MN, Scholz B, Rohkohl C, Kyriakou Y, Mohr A, Schramm P, Wachter D, Wasser K, Knauth M “Impact of a new metal artefact reduction algorithm in the noninvasive follow-up of intracranial clips, coils, and stents with flat-panel angiographic CTA: initial results”, *Neuroradiology.* 2013 Jul;55(7):813-8. doi: 10.1007/s00234-013-1165-6. Epub 2013 Apr 16.

[3] C Cay, Baltimore, MD; M Wells; A S Wang, PhD; J H Siewerdsen, PhD; T Ehtiati, PhD; C Rohkohl; et al., Quantitative Assessment of Metal Artifact Reduction in C-arm Cone-beam CT Guidance of Neurovascular Interventions, Oral presentation at RSNA 2013.

## *syngo DynaCT SMART*

*syngo DynaCT SMART* (Streak Metal Artifact Removal Technique) is a new application that can remove these image artifacts with the click of a button.

Removal of the metal artifact consists of the following steps:

First, the user identifies the metal by windowing the non-corrected *syngo DynaCT* reconstruction. From location, size, and shape of the metal objects, *syngo DynaCT SMART* determines the metal regions in each measured X-ray projection image automatically. The data generated by X-rays through metal objects are responsible for the artifacts. Therefore, they have to be replaced by a non-linear interpolation procedure using the data along the metal boundaries. This step is automatically performed by the algorithm within *syngo DynaCT SMART*.

These corrected projection images are reconstructed using an iterative metal artifact correction approach [1], resulting in a *syngo DynaCT SMART* volume that reveals the image information previously hidden by these metal artifacts.

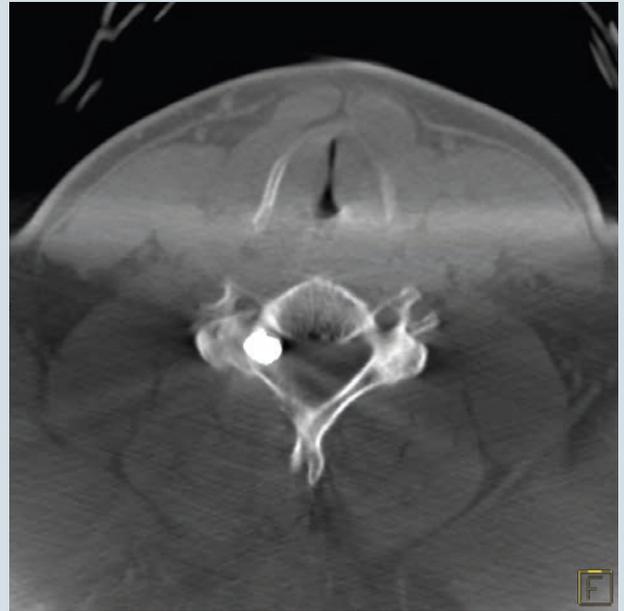
A team of collaborators worldwide evaluated a prototype version of *syngo DynaCT SMART*. They have applied it to both non-contrast and contrast-enhanced images of metal implants (e.g. stent markers, aneurysm coils, and clips) and assessed the quality of the reconstruction [2, 3 and 4].

Some results can be seen in the clinical images on the following pages.

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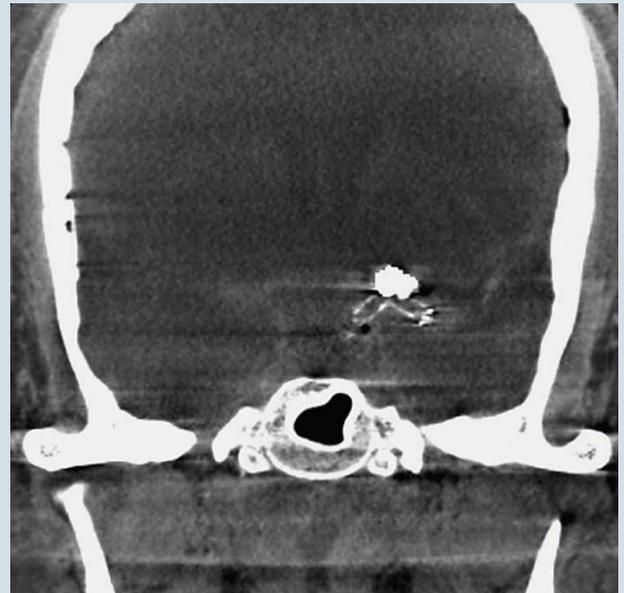
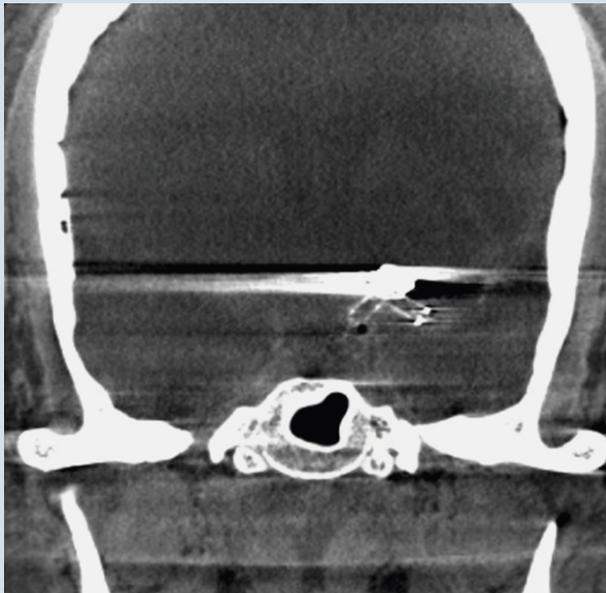
## Benefits

- Detect important diagnostic information such as bleedings close to metallic objects.
  - Save time and money by replacing endovascular procedures with intravenous follow-ups for shorter and less invasive procedures.
  - Reduce patient transfer efforts between CT and angio by performing control CT's without metal artifacts to exclude intracranial hemorrhage.
  - Increase confidence in diagnosis and decision making in the angio lab.
  - Exclude in-stent stenosis and residual aneurysm fillings in follow-up scans due to reduced metal artifacts.
  - Reduce the number of readmissions through greater confidence when discharging.
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**1** On a patient with a gunshot wound to the cervical spine, syngo DynaCT SMART was helpful in understanding the trajectory of the bullet to the vertebral artery or the dural sac.

*Images courtesy of Demetrius K. Lopes, MD, Rush University Medical Center, Chicago, USA*

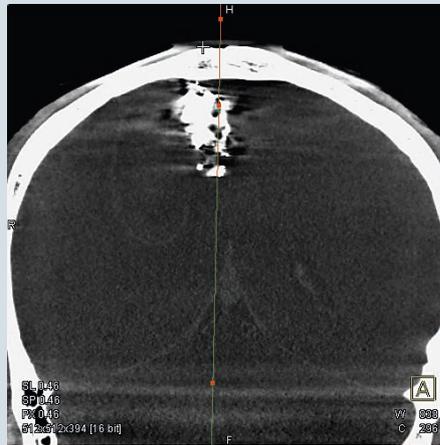
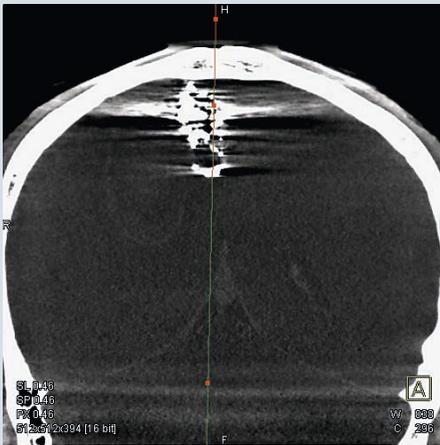


**2** 57-year-old female after stent-assisted coiling of a left internal carotid artery terminus aneurysm. Following correction with syngo DynaCT SMART, the coil mass can be visualized much more clearly.

*Images courtesy of Martin Radvany, MD, Johns Hopkins University, Baltimore, USA*

***“By using syngo DynaCT SMART in stent-coil cases, I’m more confident about excluding in-stent stenosis and residual aneurysm filling.”***

**Demetrius Lopes, MD,**  
 Director of Endovascular Surgery, Rush University Medical Center, Chicago, USA



**3** 31-year-old male with ruptured cerebral arteriovenous malformation and adjacent resolving hematoma. Following *syngo DynaCT SMART* reconstruction, the images clearly show the enhancing wall of the hematoma (particularly in the superior aspect) and delineate the anatomy far better than without *syngo DynaCT SMART*.

*Images courtesy of Michel Mawad, MD, St. Luke's Episcopal Hospital, Houston, USA*



**4A** **Pre-image:**  
Initial image without *syngo DynaCT SMART*: Cerebral aneurysm treated with stent-assisted coiling. Here, it is not possible to assess the relationship between coils and stent due to severe metal artifacts caused by the metal coils.



**4B** **Post-image:**  
*syngo DynaCT SMART* reconstruction of the same projection. The streak artifacts around coils and stent here are mostly removed to give an image quality sufficient for assessment. The oblique coronal plane showed that the stent did not kink and coils adhered to the stent very well.

*Images courtesy of Jianmin Liu, MD, Qinghai Huang, Changhai Hospital, China*



**5** 40-year-old male with a broad-based aneurysm of the middle cerebral artery bifurcation which has been treated by surgery. The control image after clipping was produced using intravenous DynaCTA.

In the uncorrected image (5A), extensive artifacts are visible making assessment of the clip difficult. After correction (5B), these artifacts are almost entirely eliminated and vascular structures adjacent to the clip become visible.

*Images courtesy of Professor Arnd Dörfler, Professor Tobias Struffert, University Hospital Erlangen, Germany*

## Contact

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[4] Stidd DA, Theessen H, Deng Y, Li Y, Scholz B, Rohkohl C, Jhaveri MD, Moftakhar R, Chen M, Lopes DK, Evaluation of a metal artifacts reduction algorithm applied to postinterventional flat panel detector CT imaging. *AJNR Am J Neuroradiol*. 2014 Aug 14 (Epub ahead of print).