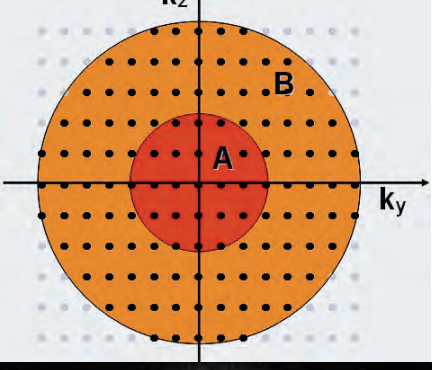



# *syngo* TWIST

## Neuro cases

www.usa.siemens.com/healthcare

SIEMENS

# *syngo* TWIST

Figure 1: Extensive predominately intramuscular diffuse left upper extremity venous malformation, involving the full extent of the upper left extremity, from the shoulder joint to the distal forearm. Thanks to Tim, flexible coil combination enabled extended FOV imaging with *syngo* TWIST. *Courtesy of NYU, USA*.

*syngo* TWIST (**T**ime-resolved angiography **WI**th **S**tochastic **T**rajectories) is a new versatile technique that further improves time-resolved ce-MRA. The new k-space coverage in *syngo* TWIST provides the user greater flexibility in tailoring temporal and spatial resolution for dynamic MR imaging. *syngo* TWIST is up to 10 times* faster compared to a standard, full k-space version of dynamic imaging.

## Clinical benefits of *syngo* TWIST:

- **Scalable temporal resolution.** Allows for efficient detection and assessment of a wide variety of vascular diseases including AVMs, fistulae and peripheral vascular disease.

- **Workflow efficient ultrafast technique.** *syngo* TWIST is fully compatible with Tim (Total imaging matrix) and parallel imaging (iPAT), making it a workflow efficient ultrafast technique. With seamless coil combinations, intuitive *syngo* user interface and flexible parameter adjustments, the set-up time and resultant exam time are reduced. Tim allows for extended anatomical coverage without repositioning patient or changing coils. Figure 1 illustrates Tim's benefits. **Additional high-res scan in the same session possibly lowers cost and helps improve diagnostic confidence.**

- **Increased speed.** Increased speed helps to overcome the timing issue in MRA. Standard sequences have longer scan times that result in visualization of veins along with arteries, deteriorating the quality of MRA (also termed as venous contamination). *syngo* TWIST allows assessment of arterial phase without venous contamination.

- **Head-to-toe applications.** In comparison to other time-resolved techniques, *syngo* TWIST is a very versatile technique thanks to its new k-space coverage. This enables head-to-toe applications like doing AVMs in the brain, acquiring carotids, aorta, peripheral angio and foot MRAs.

- **Improved image quality.** Excellent background suppression as compared to other available techniques results in accurate and reproducible diagnostic information even with smaller amounts of contrast agent. In Figure 3, a case of developmental venous angioma (DVA) shows details of the dynamic processes using a small amount of contrast agent, clinching the diagnosis against arterio-venous malformation (AVM).

*Results may vary. Data on file.

## Improving temporal resolution

To capture dynamic processes, it is important to be fast. Temporal resolution in a 3D scan can be improved by using any or a combination of the following:

- a short TR
- rectangular field-of-view (FoV)
- Partial Fourier
- reduced spatial resolution
  - in-plane resolution
  - slice resolution
- parallel imaging

To further increase temporal resolution, the user can manipulate the coverage of k-space during data acquisition. One approach to increase temporal resolution would be by covering k-space with a non-uniform rate at every point. This method is employed in faster sequences with consequences on spatial resolution and image quality as compared to standard sequences covering the entire k-space.

## *syngo* TWIST implementation

For *syngo* TWIST, k-space is sub-divided into 2 regions (Figure 4)

- a central region A (with main information about image contrast)
- and a peripheral region B (with main information about spatial resolution)

The central region (A) is scanned more frequently than the peripheral region (B), in order to achieve a higher temporal resolution. The key advantage of this technique is that a full range of k-space coverage occurs for every repetition. Thus, high-frequency information (region B) is updated at the same rate as the central region (A) so that there are no "jumps" in k-space. Overall, k-space is acquired in a random fashion even though there is a well-defined strategy behind every sampling point. This behavior explains the name of "stochastic trajectories" as part of the name of *syngo* TWIST (Time-resolved Angiography With Stochastic Trajectories).

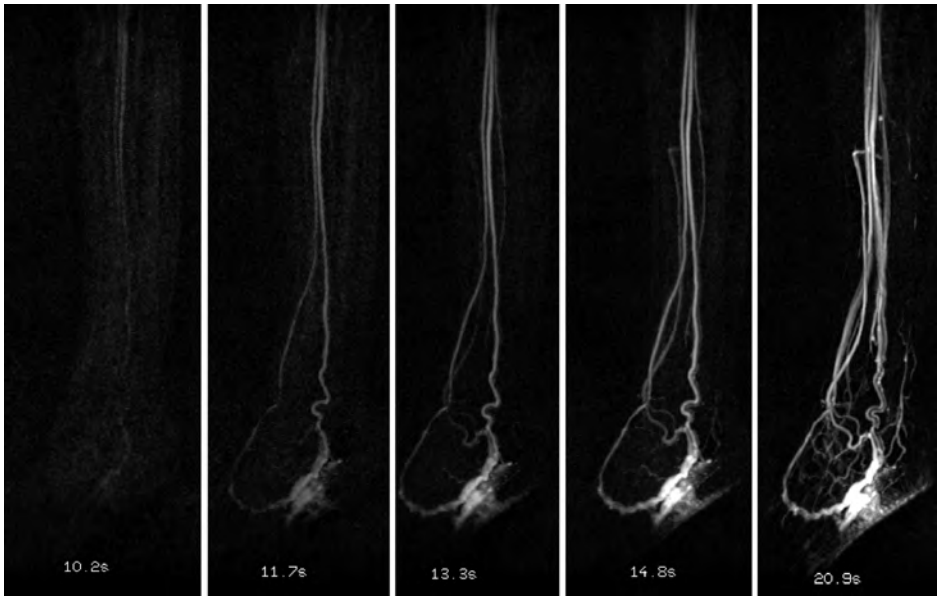


Figure 2: *syngo* TWIST in a case of AVM of foot. The dynamic information on flow can be well illustrated with high temporal resolution images and excellent background suppression. *Courtesy of Dr. J. Paul Finn, UCLA, Los Angeles, USA.*

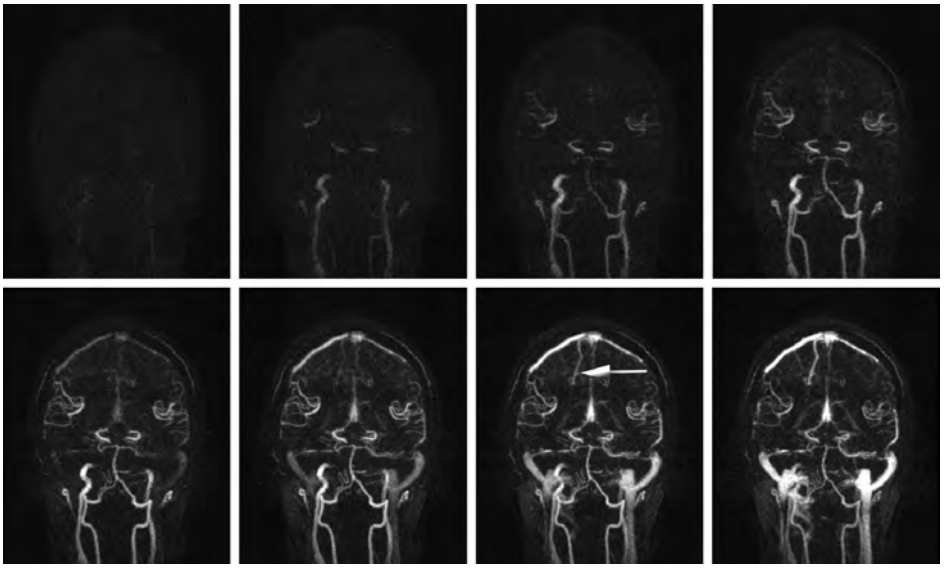

Figure 3: *syngo* TWIST demonstrating a case of associated developmental venous angioma (DVA) (arrow). A small amount of contrast injection helps demonstrate the DVA, impacting therapy and careful surgical planning to avoid resection of the vein (as it would have been if the lesion were an AVM), preventing massive venous infarction as a complication if the vein were to be resected. *Courtesy of Srinivasan Mukundan, Jr, PhD, MD, Duke University Medical Center, North Carolina, USA.*

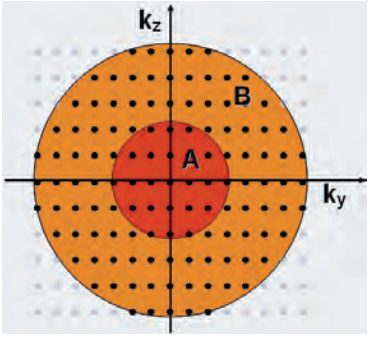


Figure 4: *syngo* TWIST uses regions A and B with different sampling properties to achieve faster update rates.

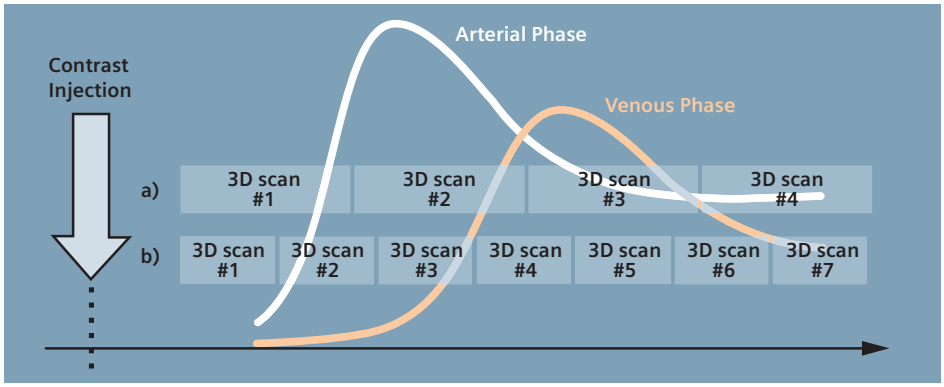


Figure 5: Basic idea of dynamic ce-MRA. A) Conventional measurements with relatively poor temporal resolution. B) with better temporal resolution, *syngo* TWIST reduces the time between subsequent 3D data sets to better distinguish between the arterial and venous phase.

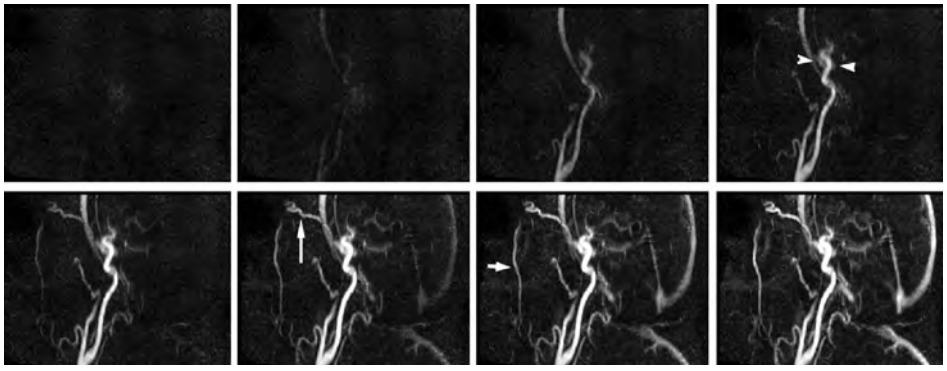

Figure 6: *syngo* TWIST for an indirect cavernous-carotid fistula (CCF). The images had adequate spatial and temporal resolution to demonstrate a "blush" in the region of the cavernous sinus (arrowheads) including clear early filling of the superior ophthalmic vein (SOV, long arrow) and facial vein (short arrow) several seconds before filling of the superior sagittal sinus. The vascular anatomy and flow dynamics demonstrated by the MRI/MRA obviated the need to perform a diagnostic angiogram. *Courtesy of Srinivasan Mukundan, Jr, PhD, MD, Duke University Medical Center, North Carolina, USA.*

## Why is *syngo* TWIST better than current ce-MRA techniques?

With better temporal resolution, as shown in Figure 5, *syngo* TWIST reduces the time between subsequent 3D data sets to better distinguish between various arterial (early, mid and late) and venous (early, mid and late) phases. This helps track the hemodynamic states much better.

## Clinical examples

**Case One**

*syngo* TWIST is a diagnostic advantage in AV fistula assessment by obviating diagnostic angiogram and help plan and utilize resources better in a neuro-interventional suite.

*syngo* TWIST was able to provide adequate information to allow diagnosis of an indirect cavernous-carotid fistula (CCF) Figure 6. The images had adequate spatial and temporal resolution to demonstrate a "blush" in the region of the cavernous sinus (arrowheads) including clear early filling of the superior ophthalmic vein (SOV, long arrow) and facial vein (short arrow) several seconds before filling of the superior sagittal sinus. The vascular anatomy and flow dynamics demonstrated by the MRI/MRA obviated the need to perform a diagnostic angiogram. Instead, a therapeutic neuro-interventional procedure with anesthesia support was planned with the goal being to provide definitive treatment. This greatly enhanced speed to treatment as the standard approach would have been to “break” after the diagnostic angiogram, have patient consultation, consent, anesthesia standby and only then perform the therapeutic procedure. Hence *syngo* TWIST helped to improve productivity and utilization of resources.

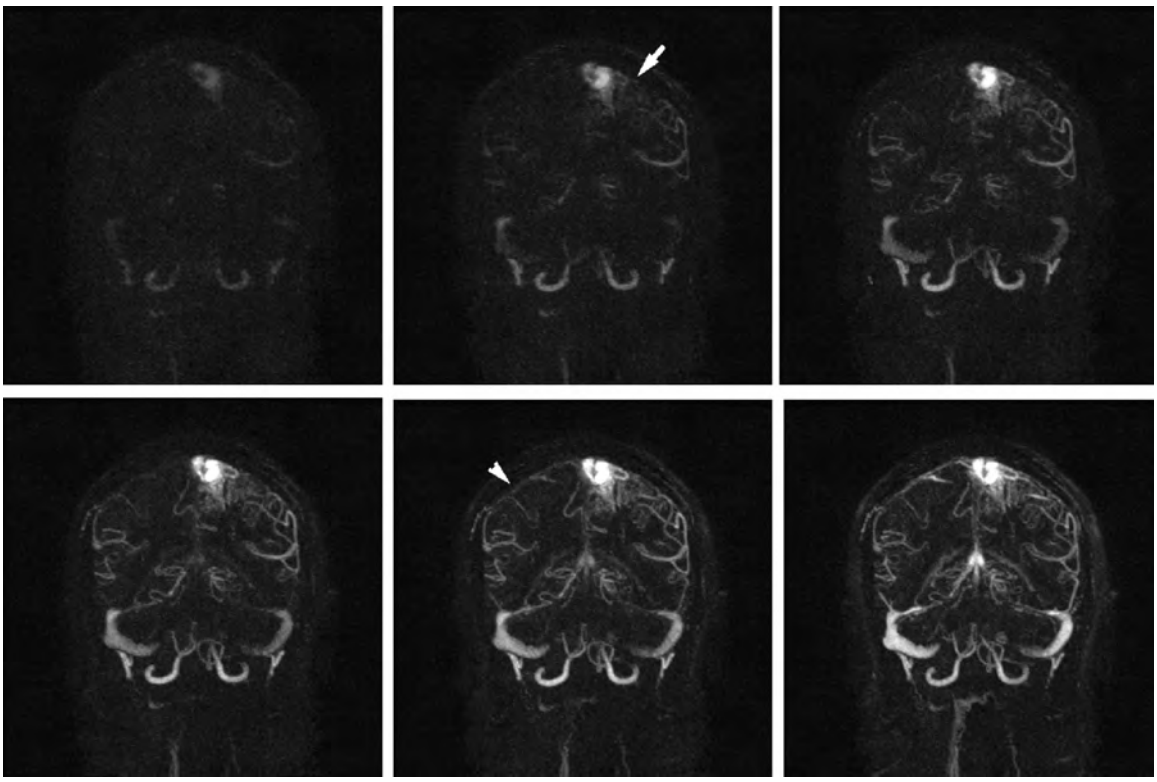

Figure 7: *syngo* TWIST for a Spetzler-Martin Grade 2 arterial venous malformation (AVM). The images had adequate spatial and temporal resolution to demonstrate arterial inflow (short arrow) as well as early venous drainage on the affected side. The more normal venous drainage is seen on the unaffected side to occur several seconds later (arrowhead). The vascular anatomy and flow dynamics demonstrated by the MRI/MRA obviated the need to perform a diagnostic angiogram. *Courtesy of Srinivasan Mukundan, Jr, PhD, MD, Duke University Medical Center, North Carolina, USA.*

**Case Two**
Good details are provided with *syngo* TWIST to grade AVMs accurately and help plan and utilize resources better in a neuro-interventional suite.

*syngo* TWIST was able to provide adequate information to allow diagnosis of a Spetzler-Martin Grade 2 arterial venous malformation (AVM) (Figure 7). The images had adequate spatial and temporal resolution to demonstrate arterial inflow (short arrow) as well as early venous drainage on the affected side. The more normal venous drainage is seen on the unaffected side to occur several seconds later (arrowhead). The vascular anatomy and flow dynamics demonstrated by the MRI/MRA obviated the need to perform a diagnostic angiogram. Instead, therapeutic intervention could be planned.

**Case Three**
*syngo* TWIST is an excellent non-invasive technique for follow-up for patients with radiosurgery treatment for AVMs.

Patients with AVM on radiosurgery treatment need to be followed with angiograms to follow-up on the AVM progress over months to years. *syngo* TWIST is an excellent non-invasive technique for dynamic information about the AVM and disease progress. All details necessary for the follow-up are available with *syngo* TWIST.

**Case Four**
*syngo* TWIST confirmed diagnosis of developmental venous angioma over an AVM thereby improving patient management with a non-invasive approach.

A patient was admitted with a brain hemorrhage. Previously, she had been diagnosed and treated for AVM at an

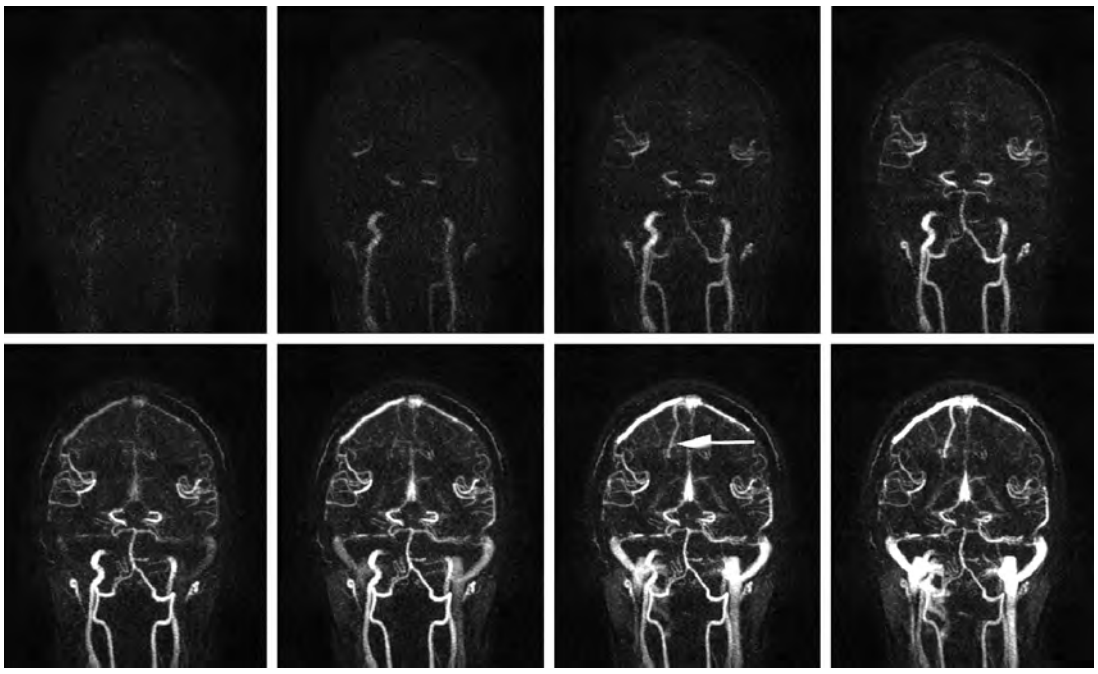

Figure 8: *syngo* TWIST demonstrating associated developmental venous angioma (DVA) (arrow), impacting therapy and careful surgical planning to avoid resection of the vein (as it would have been if the lesion were an AVM as thought outside), preventing massive venous infarction as a complication if the vein were to be resected. *Courtesy of Srinivasan Mukundan, Jr, PhD, MD, Duke University Medical Center, North Carolina, USA*.

outside hospital, and had undergone prior resection. Patient was referred for resection of a second AVM that was reported to have hemorrhaged. An alternative diagnosis of a hemorrhagic cavernoma with associated developmental angioma (DVA) was suggested. *syngo* TWIST demonstrated late filling of the prominent draining vein, confirming the alternative diagnosis. Surgical intervention was planned. The impact on therapy is that the prominent vein could be avoided and not resected (as it would have been if the lesion were an AVM as thought outside). Resection of a DVA would have resulted in a massive venous infarction of that portion of the brain adjacent to the lesion that is drained by the DVA. Therefore appropriate diagnosis was critical for treatment which was possible with *syngo* TWIST.

**Case Five**

*syngo* TWIST proved that the vascular process was not totally occlusive and synangiosis could be considered for augmentation of vascular flow in a case of post-surgical Primary Neuro Ectodermal Tumor (PNET).

*syngo* TWIST is a versatile technique in which temporal and spatial resolution can be balanced to suit the clinical need. At the Children's Hospital of Philadelphia, Dr. Robert Zimmerman exploits high-temporal resolution for the evaluation of vasculature in a post-surgery right PNET (Figure 9): "The utility of TWIST has been in time-resolved flow through vessels, where the dynamics are equally or more important than the static anatomical abnormality... Flow direction demonstrated by TWIST MRA is capable of showing that the vascular process is not totally occlusive, that there is sufficient antegrade flow in the middle cerebral artery on the affected side that consideration for augmentation of vascular flow by synangiosis (a surgical procedure used to improve blood flow to hypoperfused areas of the brain) of

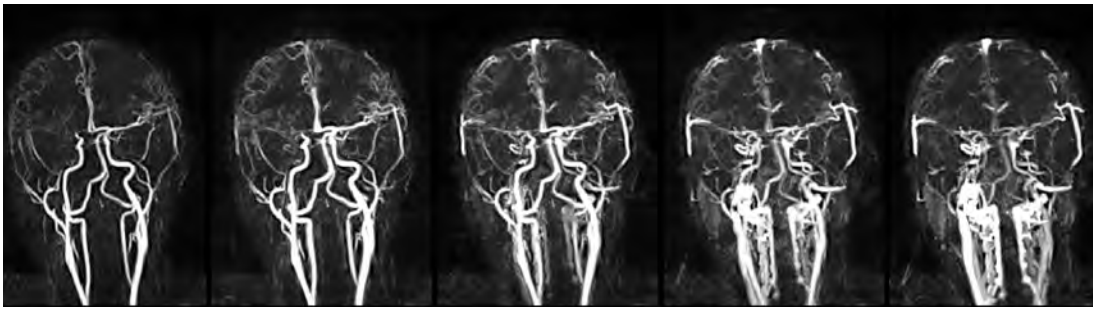

Figure 9: *syngo* TWIST dynamically illustrates hypoperfusion on the right side in a case of post-surgery PNET, however the vascular process is not totally occlusive, that there is sufficient antegrade flow in the middle cerebral artery on the affected side that consideration for augmentation of vascular flow by synangiosis. *Courtesy of Dr. R. Zimmerman, CHOP, Philadelphia, USA.*

the superficial scalp vasculature to the leptomeningeal circulation should be contemplated."

## Why is *syngo* TWIST beyond current ce-MRA techniques?

*syngo* TWIST can be used in combination with contrast injection to provide dynamic clinical information, including the evaluation of abnormal vascular anatomy as well as vascular hemodynamics and perfusion measurements. Other applications of *syngo* TWIST include examining dynamic processes such as vocal cord movement, speech formation/singing, swallowing, and other voluntary and involuntary movements in the body.

## In conclusion

*syngo* TWIST uses smooth k-space sampling scheme without "jumps" that do NOT adversely affect the point spread function and hence image quality specially for fast contrast dynamics. In addition with *syngo* TWIST the size of Region (A) (Figure 4) can be flexibly chosen, between 10% and 100% of total k-space and the sampling density of Region (B) (Figure 4) can be flexibly set, between 0% and 50% making it a very versatile technique that can be adjusted to imaging needs of time-resolved contrast-enhanced MRA.

**The key clinical benefits of *syngo* TWIST are:**

- Scalable temporal resolution
- Workflow efficient ultrafast technique
- Lower cost and improvements in diagnostic confidence as additional high-res scans can be acquired in the same setting.
- Increased speed
- Head-to-toe applications
- Improved image quality.

On account of certain regional limitations of sales rights and service availability, we cannot guarantee that all products included in this brochure are available through the Siemens sales organization worldwide. Availability and packaging may vary by country and is subject to change without prior notice. Some/all of the features and products described herein may not be available in the United States.

The information in this document contains general technical descriptions of specifications and options as well as standard and optional features which do not always have to be present in individual cases.

Siemens reserves the right to modify the design, packaging, specifications and options described herein without prior notice. Please contact your local Siemens sales representative for the most current information.

Note: Any technical data contained in this document may vary within defined tolerances. Original images always lose a certain amount of detail when reproduced.


Order No. A91MR-1100-33C-7600
Printed in USA

**Contact Address Germany**
Siemens AG, Medical Solutions
Henkestr. 127, D-91052 Erlangen
Germany
Telephone: +49 9131 84-0
www.siemens.com/medical

**Contact Address USA**
Siemens Medical Solutions USA, Inc.
Magnetic Resonance Division
51 Valley Stream Parkway
Malvern, PA 19355-1406 USA
Telephone: 1-888-826-9702

**Headquarters**
Siemens Medical Solutions USA, Inc.
51 Valley Stream Parkway
Malvern, PA 19355-1406 USA
Telephone: 1-888-826-9702

**www.usa.siemens.com/healthcare**