MAGNETOM Aera – Combining Throughput and Highest Quality MR Angiography in an Optimized Clinical Workflow

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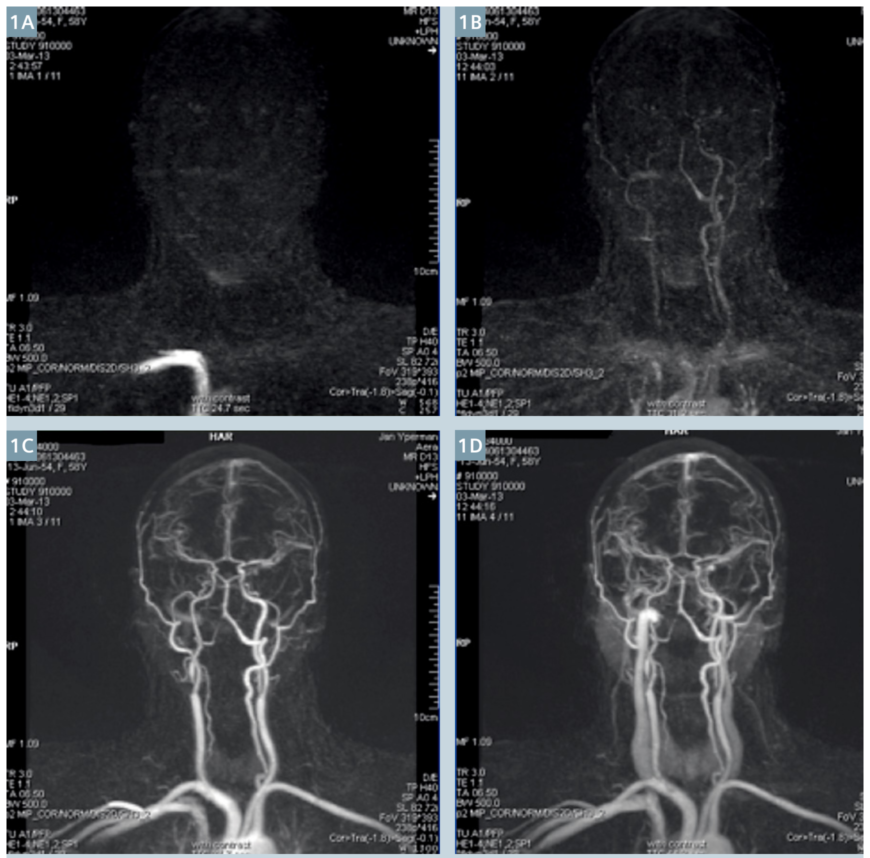
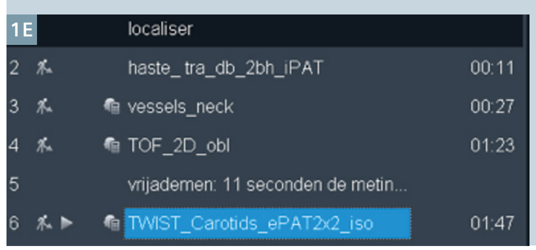
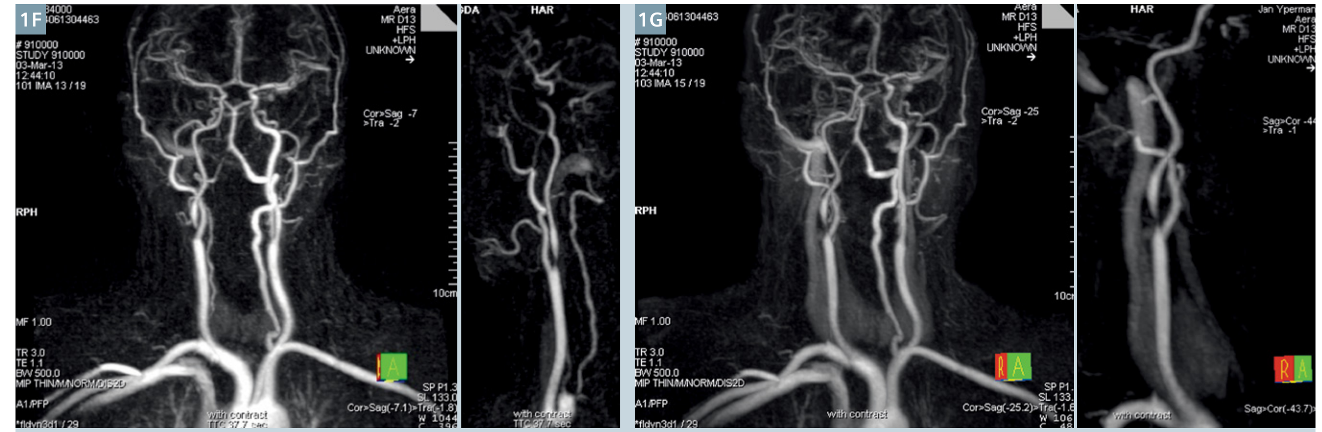
MR Angiography examinations in our institution are mainly performed in a time-resolved way using the TWIST sequence. The main rationale behind this is to obtain the dynamic information just like we could obtain using the conventional DSA technique. Indeed, having 4D data sets is of benefit to understanding the impact of stenosing lesions. To date, the only exception to this rule is the imaging of the smaller pudendal vessels in erectile dysfunction. Here we use the Angio Dot Engine to focus on high resolution. All you need to do is plan the sequence, give the resolution and coverage you want and the Dot engine adjusts the delay between injection and scanning to ensure pure arterial phase. You no longer need a pen and paper to calculate that delay.

Figure 1 shows an asymptomatic, middle-aged woman with systolic 'souffle' over the right carotid artery incidentally noted during physical examination. She has 30 pack years of smoking. Inline MIP reconstruction of the 3D data sets (every 6 seconds). Targeted reconstructions are performed in post-processing on the desired 3D dataset. The total acquisition time including sequence planning was 5 minutes.



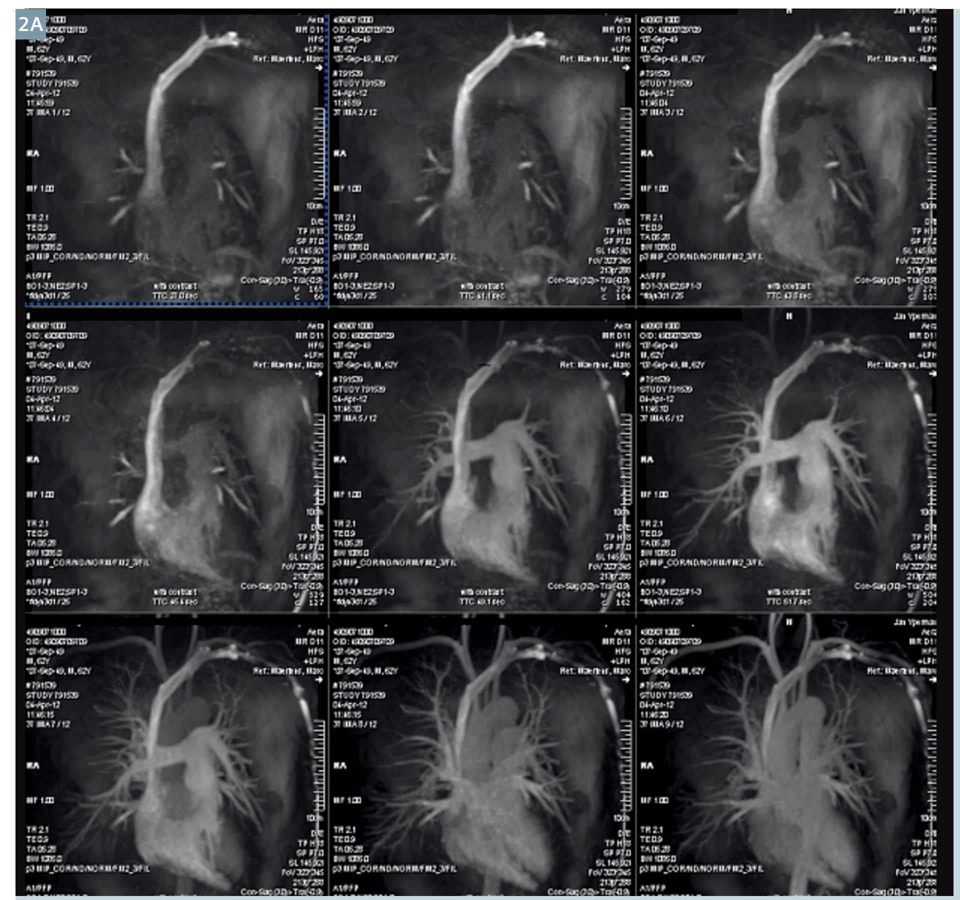


1A–E Instant results with Inline MIP of 3D data sets every 6 seconds. Spatial resolution: 09 × 09 × 09 mm isotropic.



1F–G Targeted MIP reconstructions: **(1F)** Arterial phase and **(1G)** late arterial phase 6 seconds later. Both demonstrate the high grade internal carotid artery stenosis.

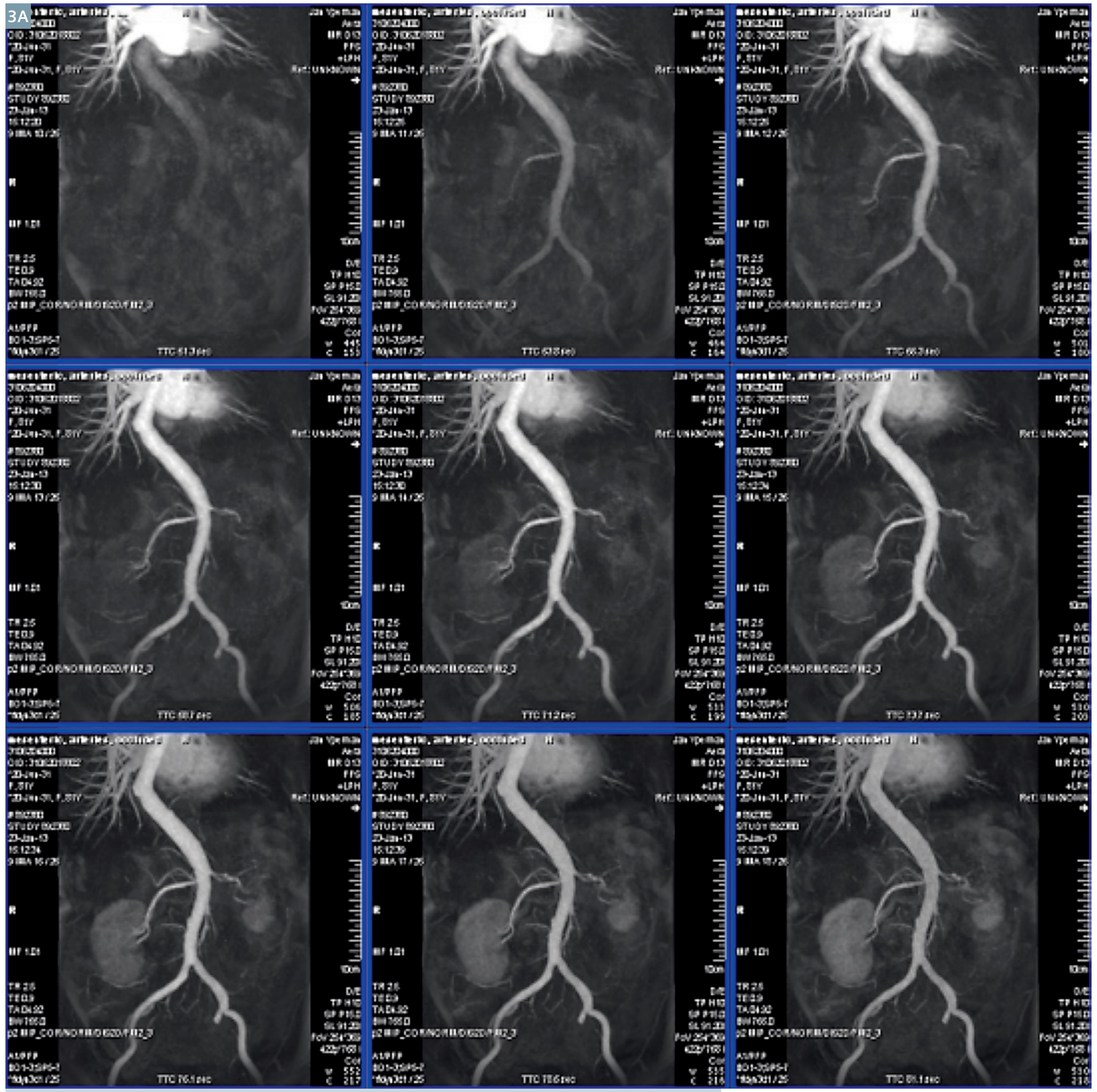
We can scan even faster: in breath-hold imaging like thoracic aorta, renal arteries or mesenteric arteries, we like to scan as fast as possible to keep the breath-holds patient-friendly and still have 3D datasets in different time points providing the dynamic information we want. Figure 2 shows a case of Marfan syndrome. We were asked to exclude ascending aorta aneurysm. Time-resolved imaging in a single breath-hold at 1.2 mm isotropic resolution gives us a 3D dataset every 4 seconds! Targeted MIP and SSD reconstruction on the pure arterial dataset provide excellent detail of the aortic root exluding aneurysm.



2A Time-resolved imaging in a single breath-hold at 1.2 mm isotropic resolution having a 3D dataset every 4 seconds.

2B Targeted MIP of the aortic root

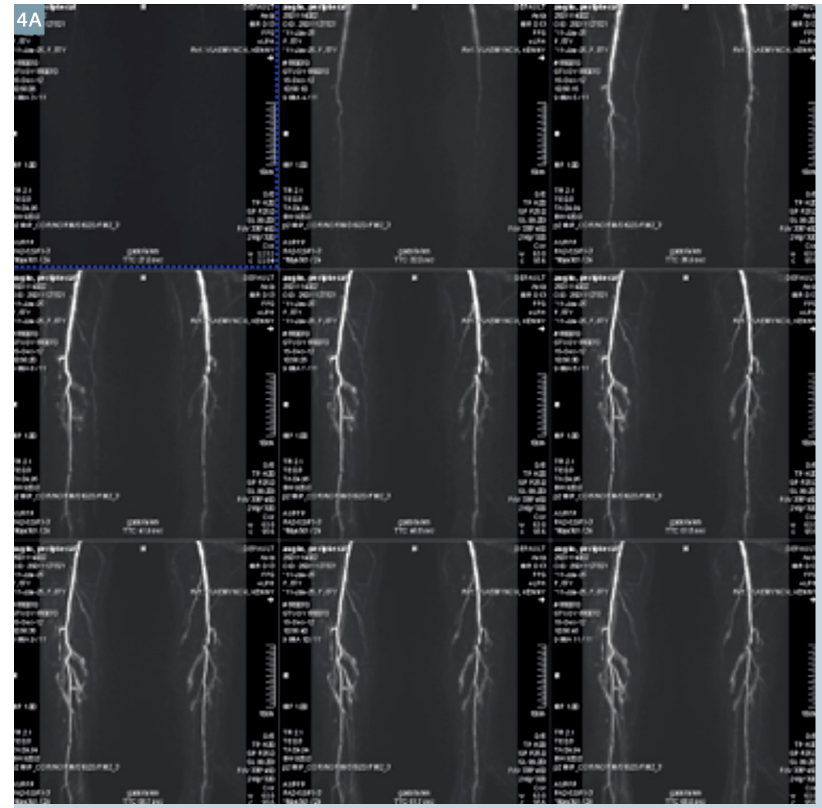
2C SSD reconstruction of the aortic root exluding aneurysm.



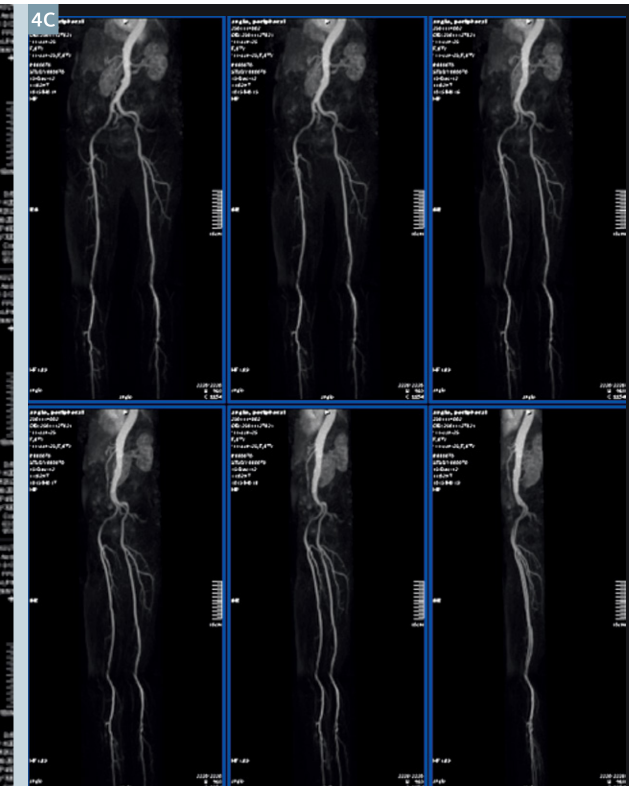
3A 3D dataset every 3 seconds, depicting a renal artery stenosis in this case of angor abdominalis.

3B Arterial phase targeted thin MIP coronal and sagittal at 81 seconds, showing renal artery stenosis.

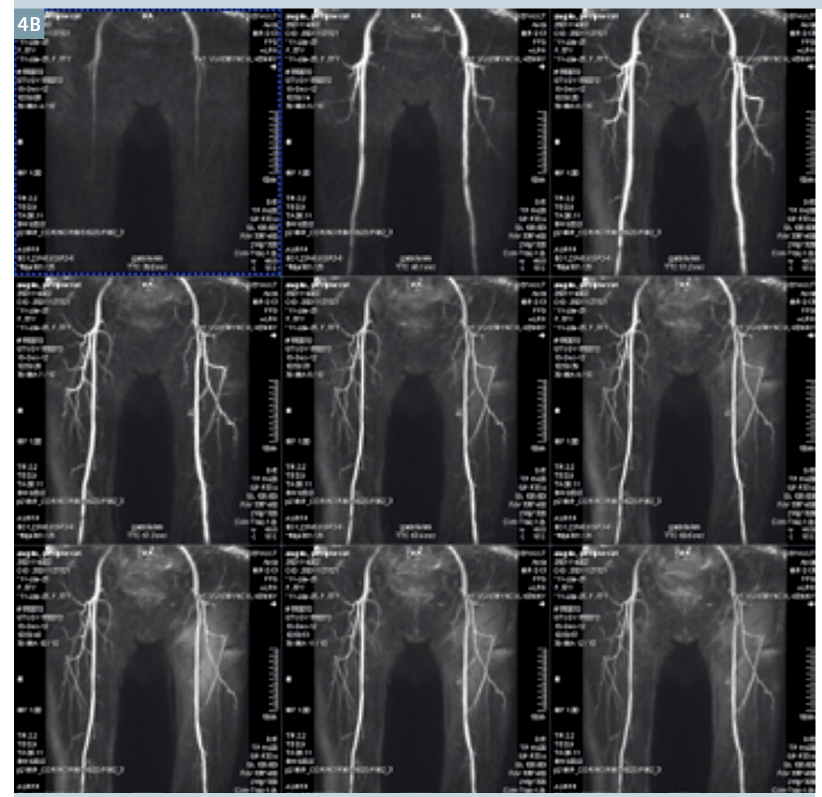
Figure 3 shows images of an 81-year-old female patient in poor condition presenting with angor abdominalis. We were asked to exclude mesenteric artery stenosis. Time-resolved imaging without breath-hold command (cooperation was non-existant) with a 3D dataset every 3 seconds already depicting a renal artery stenosis on the coronal overview images and nicely depicting high-grade stenosis on the sagittal overview series and on the targeted thin MIP of the pure arterial series.



4A Lower legs 3D series every 5 seconds.



4C Composed aorta, lower and upper leg arterial phases provide a 3D roadmap for vascular surgeons.

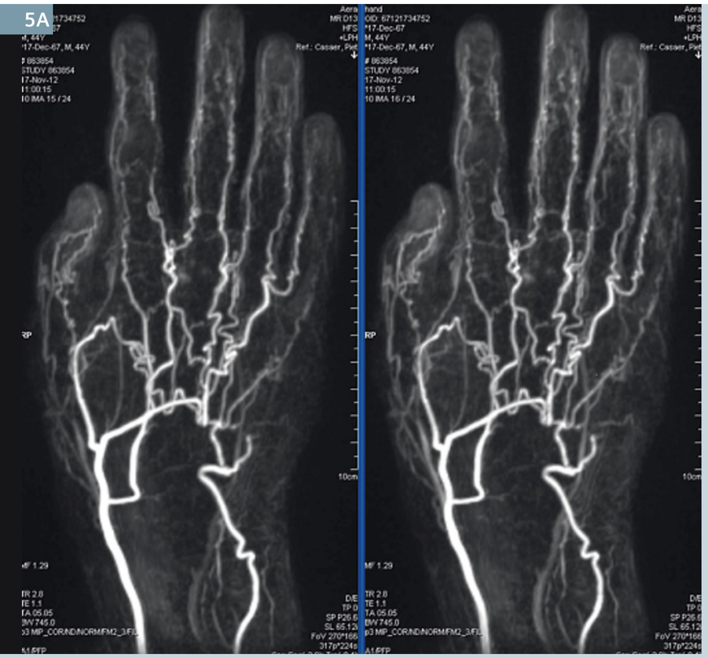


4B Upper legs 3D series in 5 seconds.

We perform imaging of the aorta and lower and upper leg arteries in a time-resolved way to pick up the dynamic physiologic information regarding the peripheral run off. We start the examination on the lower legs having 3D series every 5 seconds in an 1.1 mm isotropic resolution using 5 cc or less of 1M gadolinium contrast followed by 30 cc saline flush (Fig. 4A) we repeat that sequence for the upper legs with 6 cc gd and saline flush (Fig. 4B); and complete this with a time-resolved series of the abdomen in 1.2 mm isotropic resolution.

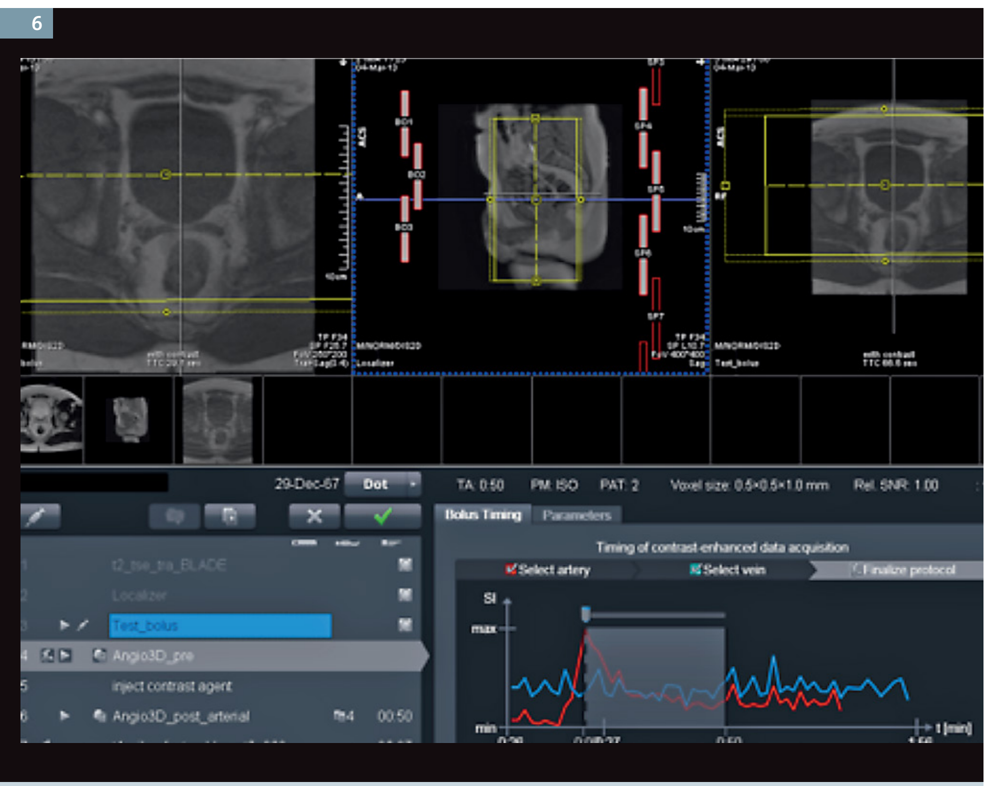
The pure arterial phases are composed and rendered in 3D (Fig. 4C) giving the vascular surgeons their roadmap to intervene and the dynamic series to have a full diagnostic skill set with physiologic information. As a bonus since you scan dynamically venous contamination is no longer an issue.

High temporal resolution in dynamic imaging can be the ultimate trick to



5A Targeted MIP reconstruction in a case of Buerger's disease. Spatial resolution 0.7 mm isotropic, using the 16-channel hand-wrist coil.

5B A case of RSI due to drilling activity. MIP of the 3D dataset at timepoint 32.5 s and at timpoint 34 s: 1.5 seconds apart!



6 Screenshot showing the advantage of the Angio Dot Engine in calculating the delay.

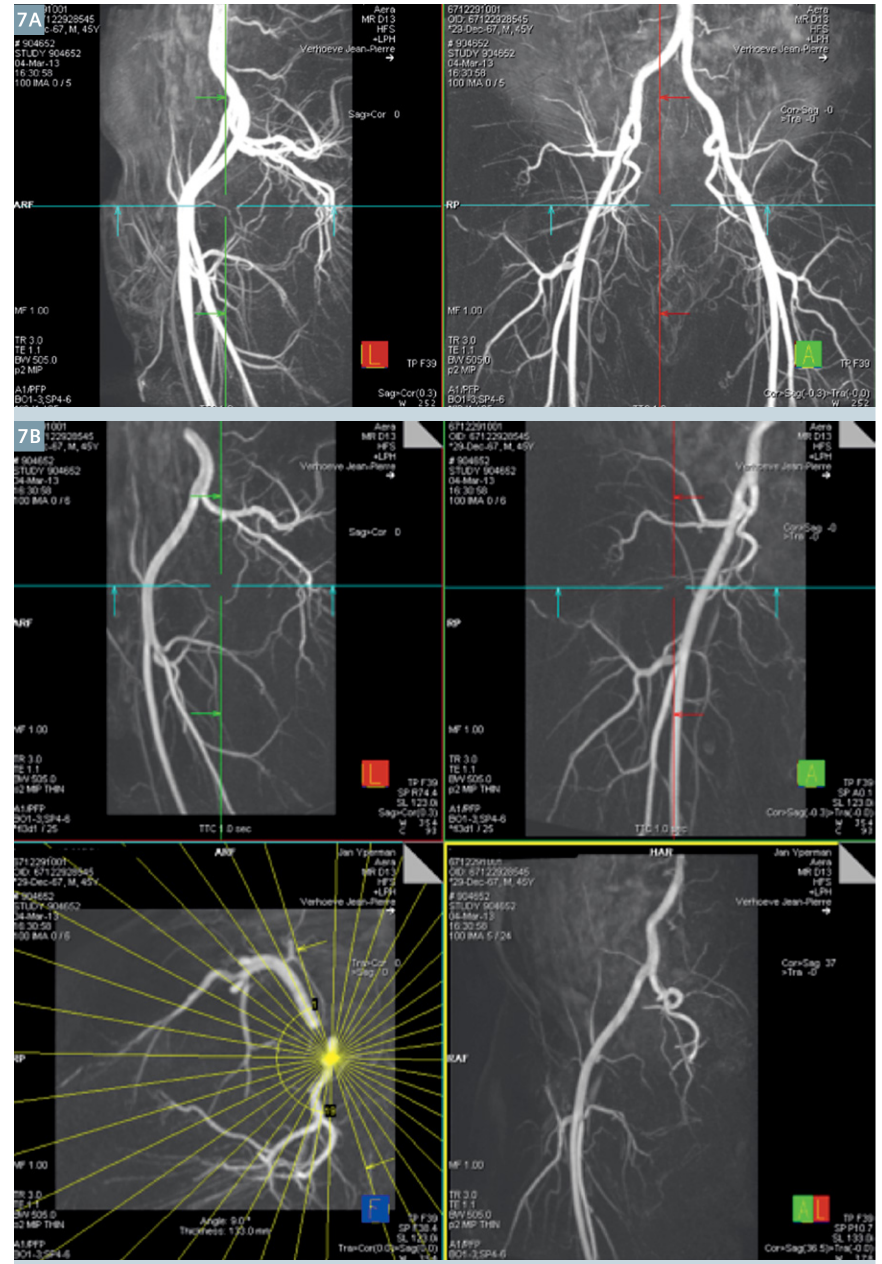
image organs with a fast venous retour like the kidneys, but also for the hand.

Figure 5 show targeted reconstruction images in a case of Buerger's disease in pure arterial phase (5A) and time-resolved overview images of a male patient with repetitive strain injury (RSI) due to drilling occupation, the small arteries of the hand and fingers are readily depicted and occlusions are readily depicted. The two 3D datasets in figure 5B have been obtained in less than 2 seconds!

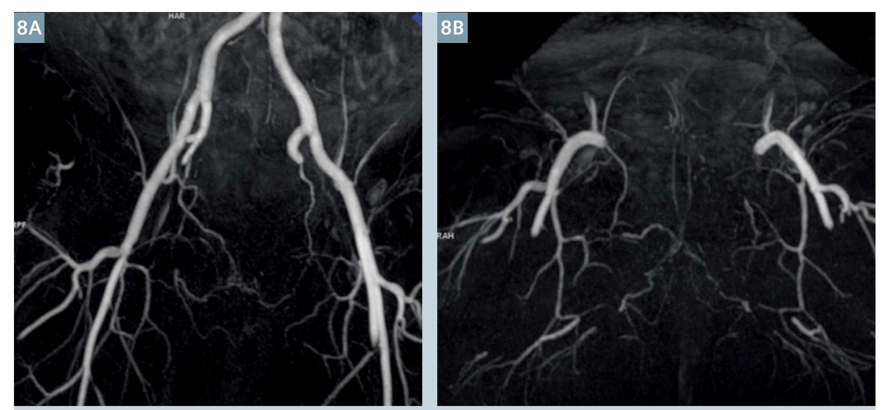
MR angiogram (MRA) of the pudendal artery: high resolution is really key in this examination since we are looking for small vessels. If the surgeon wants to perform a bypass, we want to know if distal outflow is present, so good arterial timing is the other key issue. However to obtain this spatial resolution and coverage in a time-resolved fashion is not satisfying, which is why the testbolus technique is still preferred in this clinical setting.

Whereas test bolus MRA could be tricky in the past (having a piece of paper at hand to calculate your delay), the Angio Dot Engine effectively calculates and updates the delay depending on the planned coverage / resolution (Fig. 6). The operator only has to place the region-of-interest (ROI) in the artery and vein of the testbolus image. This is easy, very robust, ultimately foolproof! Starting your contrast injection and starting your sequence at the same time gives you a pop-up-window with a countdown of the delay time until the arterial phase effectively starts. Subtraction is performed inline.

The resulting image quality of the 3D subtracted data set provides the signal and detail you need to reconstruct the angiographic images as depicted in figure 7.



7 Overview thick MIP showing excellent image quality.



8 Targeted reconstruction of pudendal artery demonstrating severe narrowing and irregularities but patent distal outflow.

Further Information

Visit us at **www.siemens.com/magentom-world** to listen to Dr. Dehem's talk on **Highest Quality Imaging in an Optimized Clinical Workflow** given during the lunch symposium at the 15th International MRI Symposium 2013 in Garmisch-Partenkirchen, Germany

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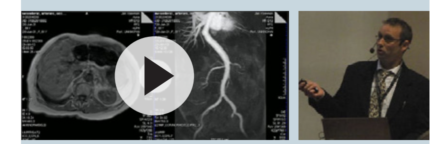

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