Minimally Invasive Procedures in Practice

—Initiatives at the Japanese Red Cross Nagano Hospital—

Medical Systems Division, Shimadzu Corporation
Hiroyuki Kinoshita

As interventional procedures become increasingly complex and advanced, there is a demand for angiography systems that help reduce X-ray doses, reduce contrast medium usage, and shorten examination times. Shimadzu's latest Trinias series angiography systems are equipped with various functions to facilitate minimally invasive treatment.

This article describes initiatives at the Japanese Red Cross Society Nagano Hospital in lower extremity endovascular treatment and catheter ablation for arrhythmia.

1 3D Roadmap with CT Images for Occluded Vessels in Lower Extremities

Vascular roadmap functions such as DSA-MAP and FluoroMAP (MAP functions) are often used for lower extremity interventions. These functions overlay a vessel image acquired by DSA over fluoroscopy images **(Fig. 1)** and support safe and effective treatment. Because the vessel images are two-dimensional, they must be re-acquired each time the observation angle changes, which can increase contrast media in situations that require multiple observation angles such as imaging the iliac artery or other vessels with complex bends in the anteroposterior direction.

The Japanese Red Cross Nagano Hospital uses 3D Roadmap functions*1 with lower extremity CT images when treating cases of chronic total occlusion (CTO) in the iliac region **(Fig. 2)**. CT slice data is uploaded onto a Trinias series SCORE 3D Workstation where necessary structures are extracted and the 3D Roadmap function combines 3D images with fluoroscopy images. The 3D Roadmap function provides vessel images at any C-arm angle in any table position without the need for additional imaging in DSA with contrast injection, and thereby reduces the exposure of patients to x-rays and the number of contrast injections.

Furthermore, if the occluded vessel is visualized on the SCORE 3D Workstation in advance, the path of the occluded vessel can be displayed in 3D Roadmap to assist with safe manipulation of guidewires and other devices. The Japanese Red Cross Nagano Hospital extracts the occluded vessel from image data by selecting just the center of the occluded vessel on multiple axial sections, creating a path along these points, then creating a virtual stent*1 along that path **(Fig. 3)**. Compared to the normal method, which traces the edges of the vessel on multiple axial images **(Fig. 4)**, this method is extremely

Fig. 1 DSA-MAP Function

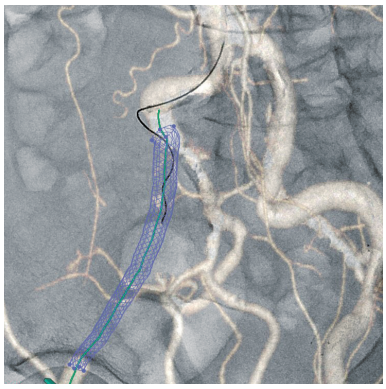

Fig. 2 3D Roadmap Function

A Word from Youichi Itoh, R.T., Department of Diagnostic Radiology

In 2018, the Japanese Red Cross Nagano Hospital updated one of its two angiography systems to a Trinias B12 unity edition. Each year, the hospital performs approx. 600 coronary angiographies (CAGs), 250 percutaneous coronary interventions (PCIs), 250 ablations, and 50 to 80 lower extremity endovascular treatments. Although radiological technologists work on a rotation system, everyone can easily operate the system even if he/she has less experience with the system, because it has simple interface. In addition, the Trinias system produces clear and good quality fluoroscopy images, therefore eye strain is not an issue and the system received positive reviews from physicians regardless of the procedure. These features may also provide scope for further X-ray dose reductions using digital zoom or other techniques.

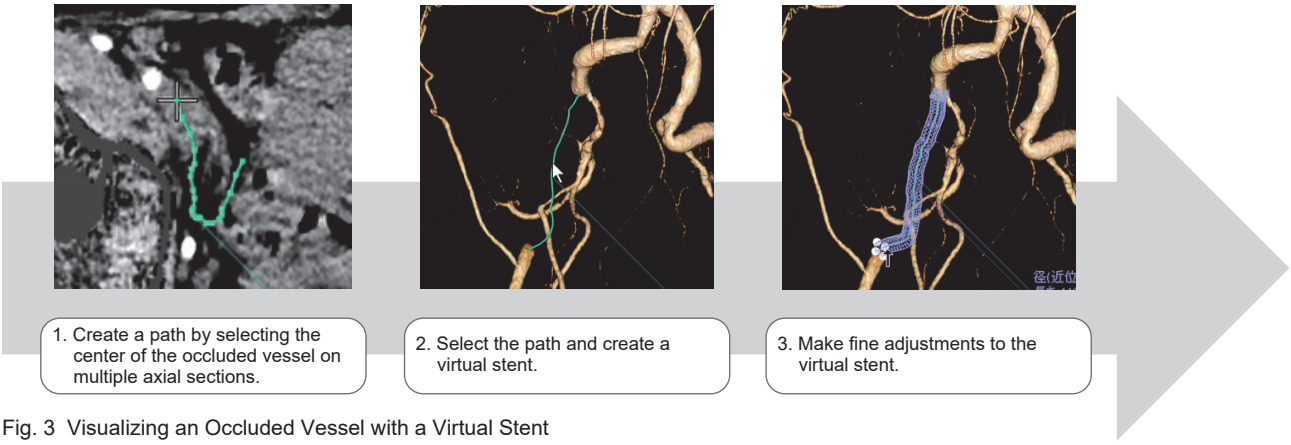

Fig. 3 Visualizing an Occluded Vessel with a Virtual Stent

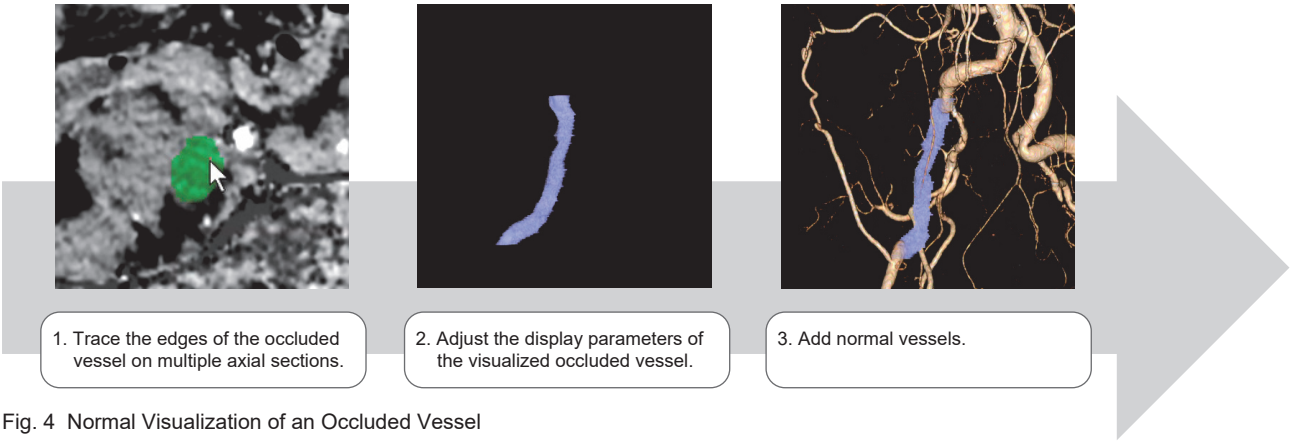

Fig. 4 Normal Visualization of an Occluded Vessel

simple and visualizes the occluded vessel relatively quickly via simple operations. Although vessel edges are not represented accurately by this method, the Japanese Red Cross Nagano Hospital notes this technique is adequate to see the route of the occluded vessel in the 3D Roadmap.

2 Using Ultra-Low Dose Mode in Ablation

Determining to what extent X-ray dose can be reduced while still completing treatment is also a topic of interest in catheter ablation for arrhythmia.

The Japanese Red Cross Nagano Hospital reduces fluoroscopy doses substantially by using the original “5 pps/ExLow-3” ultra-low dose fluoroscopy program*2. In this mode, the density parameter*4 in the 5 pps/ExLow*3 program for ablation is reduced even further from -1 to -3, and the X-ray dose is reduced by 87 % compared to the usual 10 pps/Normal program **(Fig. 5)**. With this ultra-low dose program, treatment is completed with a patient entrance reference point dose of around 200 mGy per ablation procedure (mean duration of fluoroscopy : around 65 min). In terms of image quality, users have noted the ultra-low dose program provides adequate device visibility.

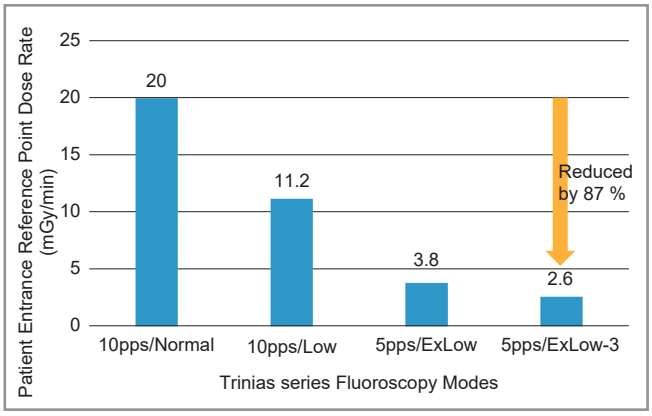

Fig. 5 Dose Rates Compared by Fluoroscopy Mode
Patient entrance reference point dose rates for FOV 8 inch, acrylic 20 cm.
• Measured values that appear in Shimadzu’s clinical application manual.
Calculated values for 5 pps.

*1 Requires SCORE Navi+Plus option.
*2 pps: pulse per second
*3 The ultra-low dose program for ablation is included from DAR-9500f version 6.8 onwards.
*4 Density is a parameter that controls the incident dose on the FPD.
Reducing density by 1, X-ray parameters are controlled to reduce the incident dose by approx. 15 %.