AC17-0006

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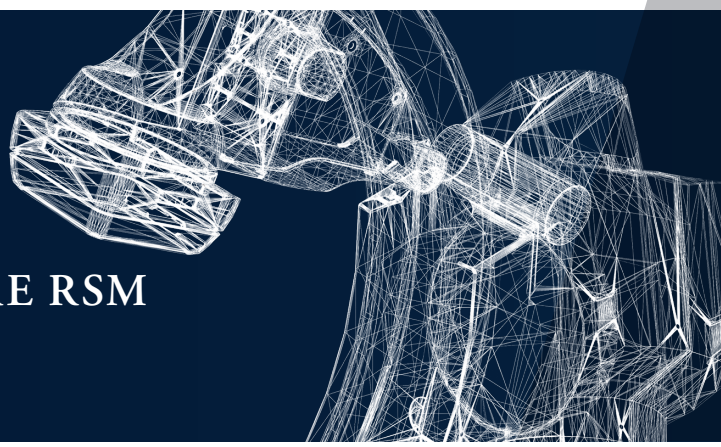

Minimally Invasive EVT with SCORE RSM Frequency Subtraction

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1. Introduction

In May 2015, our hospital introduced one of Shimadzu's Trinias Mix (hereinafter, "Trinias") systems. In the process of introducing Trinias, particular emphasis was placed on the following features.

(1) Above all else, a system that puts the patient at ease as much as possible.
(2) As a hospital specializing in cardiovascular medicine, a system capable of rendering retrograde channels (approx. 200 μm) for coronary artery CTO lesions.
(3) While designed specifically for cardiovascular medicine, a system that can also be used for peripheral lesions. Furthermore:
    1. After performing coronary angiography, can subsequently perform lower extremity angiography down to the toes
    2. Low radiation dose
    3. High image quality
    4. Reduces contrast media use

Trinias met all these conditions.

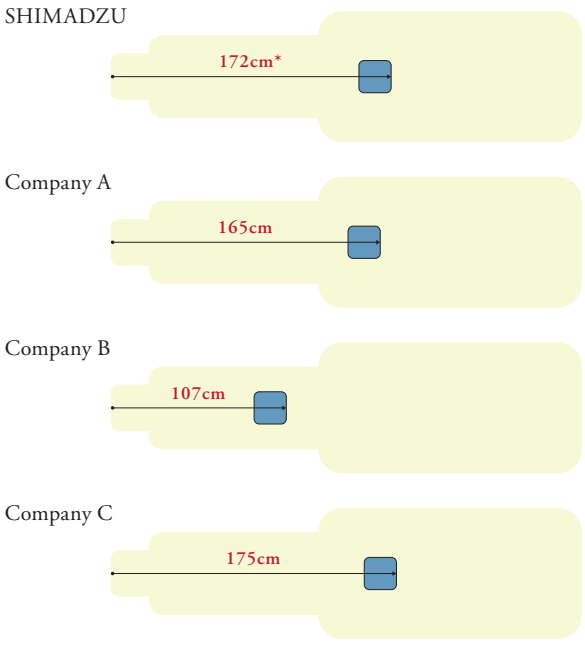
Our hospital has four catheterization rooms, each of which contains an angiography system from different manufacturers. For this article, we used this equipment to investigate the usefulness of Trinias and in particular with respect to (3) peripheral lesions.

2. Biplane System Capable of Lower Extremity Angiography after Coronary Angiography

At our hospital, biplane systems are used acquire images from two directions for both coronary angiography (CAG) and lower extremity artery angiography. Consequently, it is important we are able to continue imaging after CAG to perform lower extremity angiography to the toes without changing the orientation of the patient. In light of this, we compared to what extent the biplane system in each catheterization room can acquire images of the lower extremities.

The results showed Shimadzu: 172 cm*, Company A: 165 cm, Company B: 107 cm, and Company C: 175 cm. Assuming the standard Japanese body type, Trinias is capable of performing angiography to the toes without needing to move the patient (Fig. 1).

Fig. 1. Comparing Coverage of Biplane Fluoroscopy Between Systems

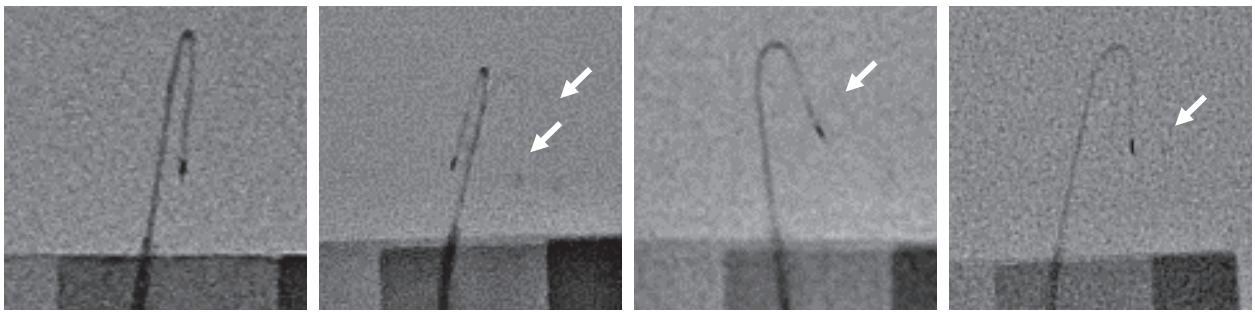


* Effective only with optional tabletop extension

3. Low Radiation Dose

There are two possible ways of reducing the radiation dose: (1) lowering the fluoroscopy pulse rate, and (2) using fluoroscopy image recording instead of radiography. First, simply reducing the fluoroscopy pulse rate from the conventional 15 pps to 7.5 pps would halve the radiation dose. However, reducing the pulse rate generally makes wire manipulation difficult due to the presence of image lag. We evaluated the images obtained with each system after reducing the pulse rate to 7.5 pps (image lag evaluation). A 0.035' Swan Exel Wire was attached to an electric drill and rotated on 15 cm of acrylic while recording fluoroscopy at 7.5 pps. On comparing the systems, we decided the fluoroscopy images acquired by Trinias were the clearest. Trinias comes with the latest SCORE PRO Advance image processing engine that makes it possible to acquire fluoroscopy images without image lag. As shown in Fig. 2, images acquired with Shimadzu's Trinias show no image lag at a low fluoroscopy frame rate (7.5 pps), while image lag is visible in images acquired by systems from other manufacturers. Based on this evidence, Trinias can be used to perform EVT at 7.5 pps.

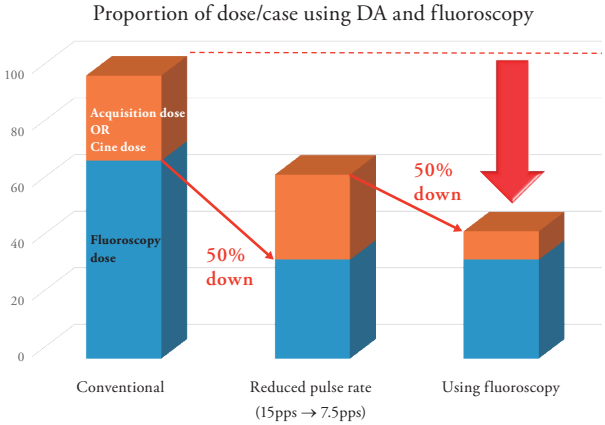
Fig. 2



SHIMADZU | Company A | Company B | Company C

Next, we will explain using fluoroscopy recording in place of radiography. Conventionally, radiographic digital angiography (DA) is used during balloon expansion and stent placement. In situations that do not require detailed images, the fluoroscopic images produced by Trinias at low pulse rates are of acceptable quality. Trinias can record up to 1,023 image frames, allowing the operator to save approximately two minutes of continuous fluoroscopic images. Fluoroscopy images can also be recorded instantaneously at the press of a button, which causes minimal stress to the operator.
The total radiation dose of procedures can be reduced by around half using the two methods described above (Fig. 3).

Fig. 3. 50 % Reduction in Radiation Dose

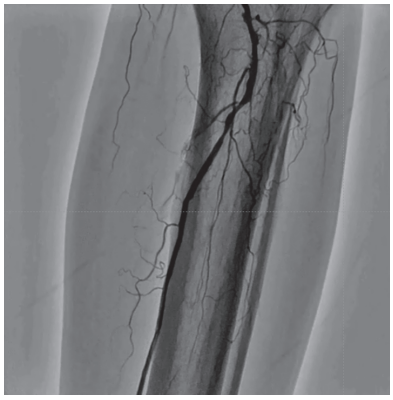


4. High Image Quality

High image quality is a necessity even at low radiation doses. Trinias has a proprietary imaging mode called SCORE RSM that generates low-frequency images from acquired images, and uses them as mask images to subtract from live images. This image processing is performed in real time, allowing SCORE RSM to display DSA-like images even during subject movement (Fig. 4). Compared to DA, bones appear with less contrast in images, and blood vessels are more visible. Although DSA produces good quality images, artifacts arise during patient movement that make the images unevaluable. Conversely, SCORE RSM images have the advantage of being unaffected by body movement.
While the radiation dose of using DSA with Trinias is lower than from other systems, SCORE RSM has an even lower radiation dose at just half that of DSA. Since image quality is comparable between general DSA and SCORE RSM despite the large difference in radiation dose, and SCORE RSM can provide us with DSA-equivalent contrast and resolution without motion artifacts, it is becoming an essential imaging mode for EVT at our hospital.

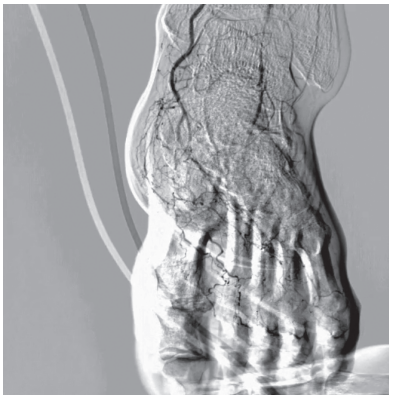
Fig. 4. Comparison of SCORE RSM and Conventional Imaging Modes

DA



- Movement possible
- Poor image contrast
- Low radiation dose per image

DSA



- No movement possible
- Image contrast is good
- High radiation dose per image

RSM

- Movement possible
- Image contrast is good
- Relatively low radiation dose per image

Table: Optimal Application of SCORE RSM

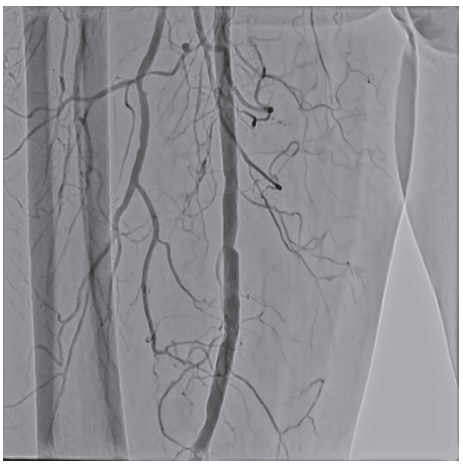
Mode	Contrast (EVT)	Contrast (tumor staining)	Resolution	Radiation dose /pulse	Panning
DA	Average	Poor	Good	100 %	Possible
DSA	Excellent	Excellent	Excellent	Approx. 300 %	Not possible
RSM	Excellent	Good	Excellent	Approx. 150 %	Possible

5. Reduced Contrast Media Use

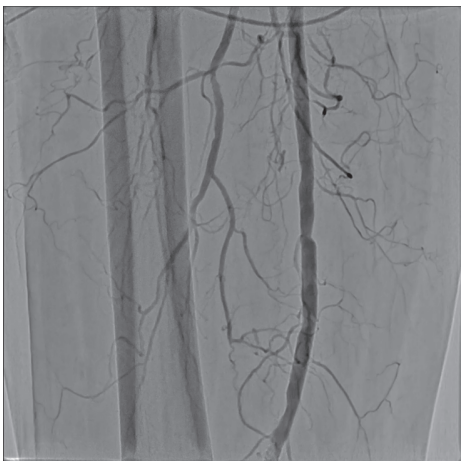
To perform imaging of all vessels from the iliac artery to the toes by DSA requires approximately six injections of contrast media, but SCORE RSM requires just a single injection of contrast media to acquire DSA-like images, reducing the volume of contrast media used. SCORE RSM also performs image processing that enhances image contrast, allowing contrast media diluted by a factor of two to be used to obtain almost the same images as are acquired with undiluted contrast media (Fig. 5).

With SCORE RSM, the visibility of vessels remains within an acceptable range even when dilute contrast media is used. These methods may be useful with patients that require limited use of contrast media.

Fig. 5. Rendering Performance of SCORE RSM with Diluted Contrast Media (Visipaque 320)



Concentration: 100 %



Concentration: 50 % (6 cc physiological saline)

6. Conclusions

Trinias offered advantages compared to other systems in terms of all four factors considered important for EVT (CAG plus lower extremity angiography, low radiation dose, high image quality, and reduced contrast media use). Our hospital performs EVT on approximately 300 patients each year, of which more than half the procedures are performed using Trinias. This figure shows the preference of operators for using SCORE RSM on Trinias, but also probably the preference of other healthcare professionals for performing EVT with Trinias, such as radiological technologists and MEs.

Although designed for cardiovascular medicine, Trinias performs at least as well as systems from other manufacturers for EVT, and is our system of first choice when performing EVT at Toyohashi Heart Center.