Vascular

Loving Everything about Trinias

Nobuhito Kaneko, M.D.

Limb Salvage Center, Kasukabe Chuo General Hospital
Nobuhito Kaneko

1. Introduction

The hospital was established in August of 1981 as Minami Kasukabe Chuo Hospital, then renamed Kasukabe Chuo General Hospital in 1998. One year before this renaming, the hospital obtained a coronary angiography system and ever since has been partly responsible for acute cardiovascular care in the eastern medical district of Saitama Prefecture.
In recent years, the hospital has treated an increasing number of patients with the peripheral arterial disease (PAD), and in 2017 the hospital established its Limb Salvage Center to provide comprehensive medical care for podiatric disorders. As well as catheter-based procedures, today the hospital also provides foot care, wound management, and surgical procedures for chronic limb-threatening ischemia (CLTI), along with multidisciplinary care using various adjuvant therapies. A distinguishing feature of the Limb Salvage Center is that it cares for patients with non-ischemic wounds as well as patients with PAD. The center accepts patients from outside its medical district and prefecture, and at any given time has 30 or more inpatients with intractable wounds. The center is also proud of the many times it has provided live demonstration on catheter-based procedures for large-scale conferences such as Complex Cardiovascular Therapeutics (CCT) and Japan Endovascular Treatment (JET).
In 2019, angiography systems in two rooms were updated and the center acquired a Trinias (12-inch) system for its No. 2 angiography room **(Fig. 1)**. I (the author) actually perform almost no percutaneous coronary interventions (PCI), normally a mainstay of cardiovascular specialists, but instead ply my trade with endovascular treatments (EVT). Around 2 years have passed since Trinias was installed, and almost all my catheter-based procedures are now performed using Trinias in the No. 2 angiography room. Image quality is excellent, as goes without saying, but a major reason for my preference is that Trinias is equipped with many useful applications for EVT. In this article, I would like to present images from real-world cases while describing the excellent features of Trinias, an angiography system I like enough to use for almost all my patients.

2. My Favorite Features

(1) SCORE RSM
(2) SCORE Chase
(3) Flex-APS (Diluted DSA)
(4) SCORE MAP (Trace MAP, Sketch Function)

(1) SCORE RSM

Whether it is coronary arteries or peripheral arteries, obtaining clear images is a prerequisite for interventional procedures and a topic of utmost importance. It is no exaggeration to say the skill and sensibility of an operator can be determined based on just one of their acquisition images.
Using conventional digital angiography (DA), which acquires live images, acquiring clear contrast-enhanced images of peripheral arteries is a challenge due to the effects of bone and the intestinal tract. Digital subtraction angiography (DSA) provides clearer images than DA because it can eliminate

Fig.1 Cardiovascular Department Staff and Trinias (Author: Leftmost on Front Row)

the effects of bone, which has made it very useful for procedures in peripheral arteries. Nevertheless, DSA is unable to eliminate the influence of intestinal peristalsis, and artifacts will occur in the aortoiliac region. DSA also requires a stationary examination table, hence a complete image of the lower extremities requires multiple acquisitions, thereby increasing the amount of contrast media administered and X-ray dose. Furthermore, many patients with CLTI are unable to remain stock-still during DSA due to involuntary movement and pain associated with intravascular osmotic pressures caused by contrast medium injection, and obtaining clear DSA images is difficult due to artifacts from this body movement.

SCORE RSM is a technology that reduces the effects of bone and the intestinal tract by creating low-frequency mask images from live images acquired during contrast-enhanced imaging and subtracting these mask images in real-time. SCORE RSM enhances only the contrast-enhanced vessels and can produce images similar to DSA while being unaffected by patient movement, even while moving the examination table **(Figs. 2 and 3)**. It also has the advantage of reducing the X-ray dose to about half that of conventional DSA.

Other than in specific cases, SCORE RSM is the first-choice imaging technique for EVT at our hospital, and DSA is only used to obtain information on fine vessels or to confirm vessel dissection after a procedure.

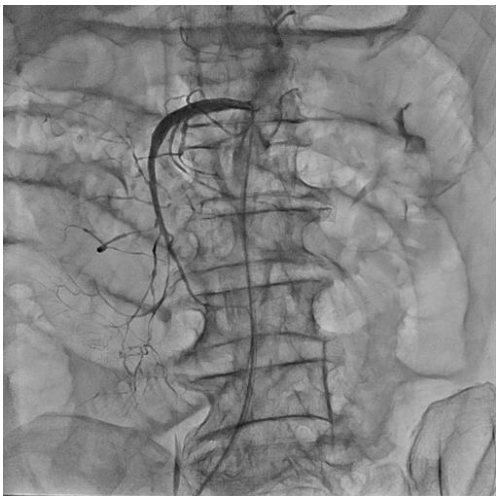

Fig.2 SCORE RSM image obtained after SMA intervention for abdominal angina. Good visualization of everything down to arterioles regardless of intestinal gas

Fig.3 Puncture of distal peroneal artery with SCORE RSM

(2) SCORE Chase

Unlike coronary arteries, regions with peripheral arteries cannot be captured entirely within a single field of view. Because of this, multiple images must be combined when creating slides and other materials of these regions, which is a painstaking task. Contrast medium concentration also varies depending on the time phase, hence creating a clear image has been extremely difficult.

SCORE Chase is an innovative application that automatically creates long-view images after an acquisition is complete and only requires the operator to press the Chase button and perform normal acquisition with examination table panning. The application is useful for procedures, but also highly valued because it reduces our workload **(Fig. 4)**.

Long-view DSA images can also be created by combining SCORE Chase with the SMART Table multifunctional catheterization table. The procedure for creating these images is as follows. First, image acquisition is performed with contrast enhancement as normal using SCORE RSM while examination table panning across the region of interest. Image acquisition is then repeated using the already-recorded table movements and without contrast enhancement. These non-contrast-enhanced images are then used to create mask images, which are then used to obtain subtraction images **(Fig. 5)**. Because this technology is capable of creating a DSA image of the entire length of the lower extremities with a single contrast media injected acquisition, it can reduce the amount of contrast medium used by about 80 % and reduce the X-ray dose by about 60 %. This makes the SCORE Chase application not only friendly to radiological technologists but also friendly to patients.

(3) Flex-APS (Diluted DSA)

PAD and especially CLTI is often coexisted by chronic kidney disease (CKD). Patients with conservative-stage CKD must be administered as little contrast medium as possible to avoid contrast-induced nephropathy (CIN), and it is also good

practice to limit the amount of contrast medium administered to patients who are undergoing maintenance dialysis to avoid volume loading. For these reasons, we often perform DSA with diluted contrast medium as reported by Hayakawa et al. for EVT[1]. Instead of diluting with physiological saline, I avoid volume overloading by drawing blood from the sheath and diluting contrast medium with this blood. When operating in the dilute medium mode, the injected contrast medium is almost iso-osmotic and there tends to be less patient movement associated with changing intravascular osmotic pressures. However, because diluted DSA needs greater enhancement of contrasts in the resulting images on the display monitor compared to conventional DSA, diluted DSA has the disadvantage of being more prone to artifacts from involuntary or other movements.

Fig.4 Contrast-enhanced image of arteries in both lower extremities with SCORE Chase

Fig.5 DSA image of Fig. 4

Flex-APS is an application that automatically corrects misregistration artifacts arising from body movement during DSA. By applying an appropriate correction to each pixel, Flex-APS can even correct for twisting motion that would be outside the scope of conventional motion correction. Another very convenient aspect of Flex-APS is that correction is applied in real-time, so corrected images with few artifacts can be observed during an ongoing examination. The ability to acquire clear images with few artifacts also provides the major benefit of fewer re-acquisitions, which further reduces the X-ray dose and amount of contrast medium used

The images Trinias acquires in the dilute medium mode are worthy of special mention. With non-Shimadzu systems, a rough sand-like grain is apparent in background areas of the image due to the processing they use to enhance contrast in the image, hence the dilute medium mode is kind on the patient's kidneys but not on the operator's eyes. The dilute medium mode of Trinias has no such issues; at a glance, images are accurate enough to be indistinguishable from normal DSA images **(Fig. 6)**.

Using undiluted contrast medium in the dilute medium mode also provides clear visualization of collateral blood flow and fine distal arteries such as those below the ankle, where detailed information is difficult to obtain with normal contrast enhancement **(Fig. 7)**. This technique is very effective in difficult EVT cases, such as for arteries below the knee in patients with CLTI.

(4) SCORE MAP (Trace MAP, Sketch Function)

Accurate procedure area determination is as important for EVT as for PCI. For example, inaccurate stent placement at the aortoiliac bifurcation and resulting displacement into the aorta will cause problems for subsequent procedures that manipulate wires or devices in the same area. Even in the femoropopliteal artery region, where patency is gradually improving due to the emergence of various therapeutic devices, if the area where the final device is used is narrower than the area that underwent lesion preparation, restenosis will be induced. Accuracy is also a requirement for stent placement at the origin of the superficial femoral artery (SFA). In below-knee arteries where long-term patency is not assured, there is a concern that unnecessary intervention may lead to future prolongation of the lesion.

Roadmap functions are extremely effective tools for performing accurate procedures. Other than

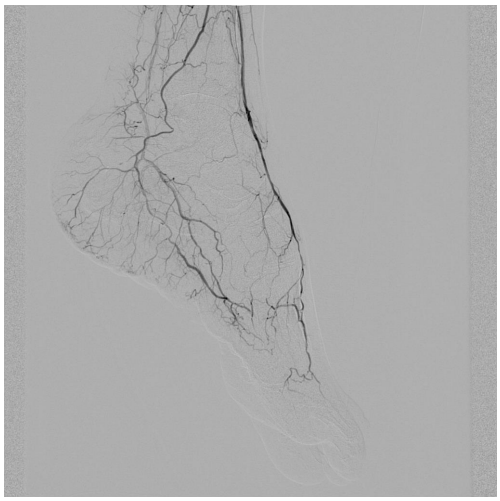

Fig.6 Contrast-enhanced image of a foot with diluted contrast medium. At a glance, the image is indistinguishable from a normal DSA image.

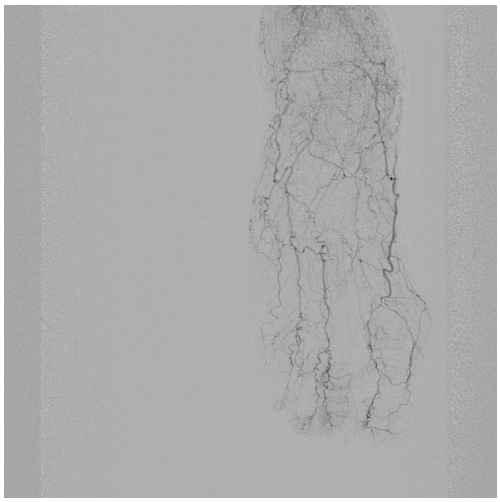

Fig.7 Dilute contrast-enhanced acquisition mode image with undiluted contrast medium. The main artery below the knee is occluded, but visualization down to peripheral arterioles is good.

procedure area determination, roadmap functions help when manipulating guidewires and can reduce contract medium usage and X-ray dose by reducing the number of times contrast injection is used. Previous roadmap functions had the drawback of turning the entire vessel lumen white, which had a negative impact on the visibility of guidewires and devices.

This problem has been resolved by Trace MAP. Unlike previous roadmap functions, Trace MAP automatically extracts just the vessel border from DSA images and overlays this outline onto fluoroscopic images without turning the entire vessel lumen white, which ensures guidewires and devices remain visible **(Figs. 8 and 9)**. Trace MAP also supports magnification and reduction of the field of view, hence the Trace MAP image can be displayed on the part of the image where it is needed. This is extremely useful because when a stent is being placed at the SFA origin, an overview image can be viewed before focusing on the bifurcation area **(Figs. 10 and 11)**.

In EVT, a retrograde puncture of the distal artery is often used to create a bidirectional approach from the distal and proximal sides **(Fig. 12)**. Trace MAP is also an extremely useful tool in these situations.

Even simpler than Trace MAP is the Sketch function. Sketch allows the operator to draw guidelines manually on fluoroscopic images with the mouse in the control room or the joystick in the examination room. Although Sketch is much simpler than Trace MAP, its simplicity also makes it convenient and easy to use and a valuable tool in stent positioning.

I will use either Trace MAP or Sketch for procedures depending on the situation.

Fig.8 Trace MAP-guided wire manipulation for CTO from SFA origin

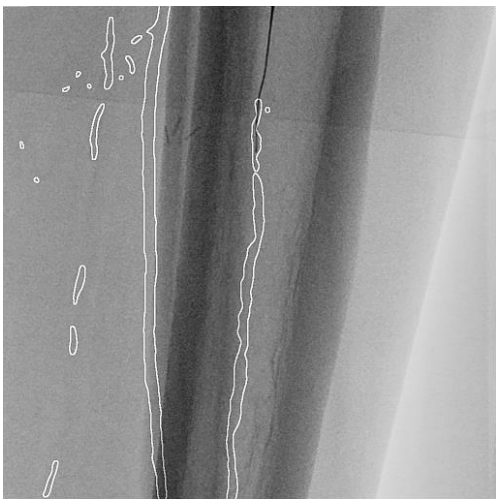

Fig.9 Trace MAP-guided wire manipulation for below-knee arterial lesion

Fig.10 Trace MAP-guided stent placement at iliac arterial bifurcation

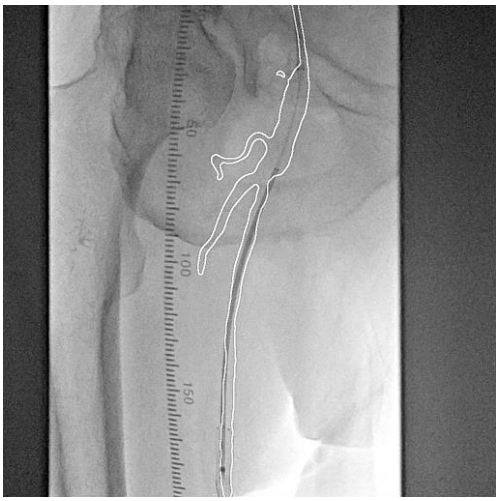

Fig.11 Trace MAP-guided stent placement at SFA origin

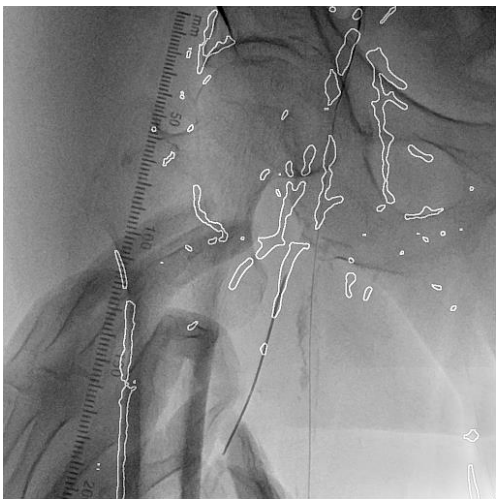

Fig.12 Trace MAP-guided distal puncture of deep femoral artery

3. Summary

In this article, I list the greatest features of Trinias, an angiography system of which I am entirely enamored.

The westernization of dietary habits is increasing the numbers of patients with lifestyle diseases, and PAD may be considered a national disease in Japan, particularly since the number of Japanese people on maintenance dialysis is so high. EVT techniques and devices are constantly evolving, and procedure outcomes are improving dramatically both in the short and long term. As a result, peripheral artery specialists and many other interventionists will encounter EVT with increasing regularity in the coming years, and reducing the invasiveness of EVT for patients and the stress of EVT for operators will become important topics of interest. On that note, Trinias is my favorite angiography system and I love everything about it.

Reference

1) Hayakawa, et al. Heart and Vessels, 15 Apr 2019, 34(11): 1740-1747