# Vascular

## An AI-Equipped System That Continues to Evolve
## —Experience and Clinical Use of Trinias Opera—

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Abstract

This article reports on the experience and clinical use of Shimadzu's Trinias Opera, primarily in the field of structural heart disease (SHD) interventions.

The discussion focuses on the ease of control and efficiency required in SHD procedures, including the flexible movement of the C-arm and marking using the Sketch function.

In addition, clinical images obtained using the AI Filter, which contributes to improving the quality of catheter interventions, and the characteristics of function updates through SCORE Link are presented.

## 1. Introduction

Our hospital is a 64-bed cardiovascular specialty hospital that opened in October 2008 in Sunada, located in the eastern part of Nagoya City, near Nagoya Dome **(Fig. 1)**. Its parent hospital is Toyohashi Heart Center, and carrying forward that spirit, we accept emergency patients 24 hours a day, 365 days a year. The hospital has five floors: the first floor is a parking area, the second floor is the outpatient floor, the third floor houses the cathlabs and operating rooms, and the fourth and fifth floors are wards. In the outpatient department, we have one CT system, one MRI system, and seven ultrasound systems—five for cardiac examinations, one for vascular examinations, and one for other applications. We devote considerable effort to diagnostic imaging so that all examinations and explanations of results can be completed on the same day as the outpatient visit. There are four cathlabs, where day-case CAG, percutaneous coronary intervention (PCI), peripheral endovascular therapy (EVT), structural heart disease (SHD) interventions, arrhythmia procedures, and other catheter interventions are performed in a shared manner. There are also two operating rooms, equipped with two cardiopulmonary bypass systems, enabling us to respond to emergency surgery. The hospital's procedural and examination volumes are shown in **Fig. 2**.


**Fig. 1** Exterior of Nagoya Heart Center

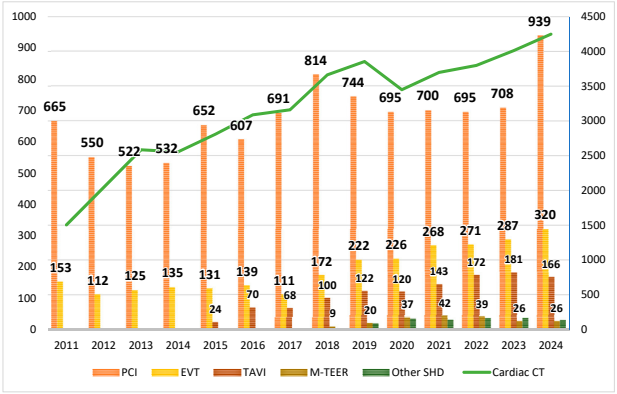


**Fig. 2** Examination and procedure volumes by procedure type at Nagoya Heart Center from 2011 to 2024

Among the four cathlabs described above, the hybrid room is equipped with Shimadzu Corporation's Trinias B8s with SCORE Opera, hereafter referred to as Trinias Opera **(Fig. 3)**. It is used for a broad range of applications, not only in the cardiac and lower-extremity fields but also for SHD interventions.

For the patient table, we selected a standard catheterization table rather than a surgical operating table. Although the catheterization table we selected has some functional limitations compared with a surgical operating table, it is more familiar to us and offers better ease of control for our primary use in catheter interventions, including SHD procedures.

**Fig. 3** The Trinias Opera system installed in January 2025

## 2. A History That Has Progressed Together with the Evolution of Shimadzu Products

Our hospital has used Shimadzu angiography systems for approximately 20 years **(Fig. 4a)**. Initially, it was an early-generation FPD system, and several points for improvement were identified; however, by incorporating feedback from the clinical site and making improvements one by one, the system has evolved into its current form. In particular, during the era of the Trinias MiX series **(Fig. 4b)**, which was two generations before the current model, the concept of "Low Dose, Low Rate PCI" was proposed. Image processing that could create images without being affected by subject motion and without a sense of after-image was introduced, and as a result, the product attracted considerable attention in the field of cardiac catheter interventions.

This time, in pursuit of further evolution, we employed the fully remodeled Trinias Opera series at an early stage in the Tokai region. Its features are described below.

**Fig. 4a** Early model of the FPD system, September 2008

**Fig. 4b** Trinias MiX series, October 2014

### 2.1 Accelerated Machine Response

Operating response is directly linked to examinations and procedure time; therefore, it is an item that should be carefully considered when selecting a system. First, regarding the operating speed of the C-arm, we experimentally compared the speed of five biplane systems, including both older and newer models owned by the Heart Center Group. The comparison was performed as follows:

1. Start from the parking position in a biplane setting.
2. Assume that three routine views in total are acquired using the biplane system.
3. Measure the time required until arm movement for the third view is completed.

Of course, because the systems vary in age, this was not a comparison among only the latest systems. Nevertheless, needless to say, the most recently installed Trinias Opera was the fastest, and compared with the slowest system, there was a maximum difference of 30 seconds.

It goes without saying that this difference is substantial in daily clinical practice.

Button-control response is also important. While many systems cannot be controlled at all during

fluoroscopy, Trinias stands out. Owing to the system design inherited from previous models, reference images can be freely controlled even during fluoroscopy. In addition, if the protocol change button is pressed during fluoroscopy, the selected menu is executed immediately once fluoroscopy is stopped. In other words, the next control can be preselected during fluoroscopy. This has the potential to markedly reduce stress for the medical staff operating the system.

A new function for radiation dose reduction has also been incorporated. This is the Auto SID function. To reduce radiation dose and maintain high image quality, it is fundamental and extremely important to position the FPD as close as possible to the patient. Normally, the FPD can be positioned only as close to the patient as the stored position allows; if closer positioning is required, the operator must manually adjust the FPD position each time to bring it closer to the patient. With Trinias Opera, when the FPD is brought close during a procedure, the system automatically recognizes the distance according to the subject and supports automatic close positioning from the next time onward. This reduces the burden on both the operator and the technologist and prevents situations such as forgetting to bring the FPD closer. It is a very thoughtful function.

### 2.2 Improved Device Visibility with AI Filter

Filtering processing using AI—deep learning—has improved device visibility even under low-dose conditions, enabling procedures to proceed more safely. Details are left to the manufacturer's explanation,[1)] but further improvements in image quality and dose reduction are expected as AI continues to advance. Clinical images are presented in the case examples in Section 3.

### 2.3 Growth Through SCORE Link

Angiography systems are used for an average of more than 10 years, and because they are operated over a long period of time, functional obsolescence is an issue. Manufacturers continually release new functions; however, in reality, it is difficult to purchase every new function each time it becomes available. When we see presentations at other hospitals or at congress introducing new functions on the same model as ours, we often feel disappointed by the long interval until the next renewal. SCORE Link, an application platform, is provided to solve this issue. By subscribing to this platform, the system can be kept up to date at all times, allowing us to expect that clinical issues arising in practice can be addressed as needed. As product quality improves, even longer system life can be anticipated, and for users, this type of mechanism is highly valuable.

## 3. Clinical Cases

In addition to the conventional image processing, SCORE PRO Advance, Trinias Opera incorporates AI Filter to improve images. Clinical examples are shown below.

**CAG Comparison Case**

Coincidentally, CAG images acquired in the same patient using both the previous and current Trinias systems were available and are shown below. Although it may be difficult to appreciate in print, improvements in contrast and graininess can be observed **(Fig. 5)**.

**Fig. 5** Left: conventional image processing. Right: new image processing.

**Stent Enhancement**

For stent visibility, two types of applications can be used depending on the situation. SCORE StentView **(Fig. 6)**, which enables real-time visualization as moving images, is useful for device positioning, whereas SCORE StentShot **(Fig. 7)** generates enhanced images, making it easier to evaluate stent expansion. In addition, PCI View has newly been introduced as a tool to facilitate smooth progress of the procedure. When the fluoroscopy pedal is released, a previously specified image sequence is immediately replayed on the fluoroscopy monitor. From the operator's viewpoint, this function allows the operator to concentrate on the fluoroscopy monitor while retaining the residual impression of a key angiogram, without shifting the gaze to a reference monitor.

**SHD Cases**

Our hospital was approved as a facility authorized to perform TAVI in February 2015, and we performed our first TAVI case in March 2015. As of June 2025, we have performed 1,231 TAVI procedures,

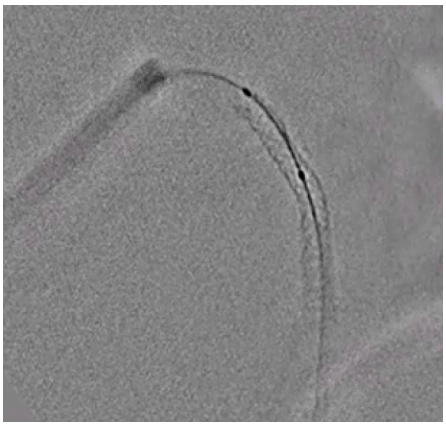

Fig. 6 SCORE StentView

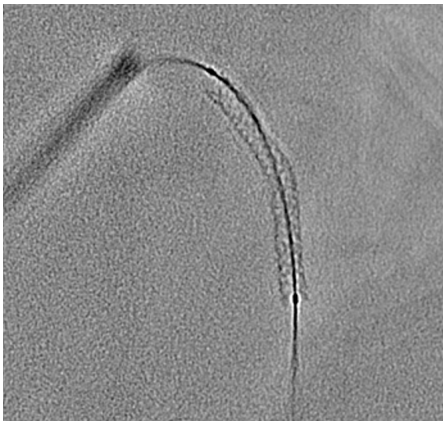

Fig. 7 SCORE StentShot

in addition to percutaneous mitral valve repair procedures and left atrial appendage closure procedures. Important requirements in SHD include the following:

- The frontal C-arm can be positioned obliquely.
- Markings can be made freely on the fluoroscopy monitor using Sketch or tracing.

Before a procedure, intubation and transesophageal echocardiography probe insertion may be performed. During the procedure, echocardiographic control may be needed, and in cases performed under local anesthesia, emergency intubation may be required. These are performed by the anesthesiologist at the patient's head side, so sufficient working space is necessary. In addition, because these procedures are performed there, the ventilator or anesthesia machine and the ultrasound system itself must also be placed at the head side. Therefore, if the C-arm is positioned at the head side, the procedure becomes very difficult. Trinias allows oblique positioning of the frontal floor-mounted C-arm **(Fig. 8)**, making it a suitable system for smooth procedure workflow. Recently, during TAVI valve implantation, we have also attempted to grasp subtle changes during deployment by using the Sketch function to mark the lower edge of the sinus of Valsalva and the lower edge of the TAVI valve **(Fig. 9)**. In left atrial appendage closure procedures, tracing the morphology of the left atrial appendage improves procedure efficiency **(Fig. 10)**.

Fig. 8 By positioning the frontal floor-mounted C-arm obliquely, a wide space can be created at the head side.

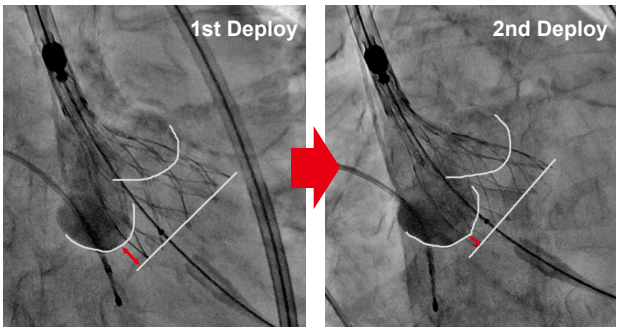


Fig. 9 During TAVI valve implantation, the Sketch function is used to grasp minute movements during deployment. In this case, the position was adjusted using the line after the first deployment as a guide.

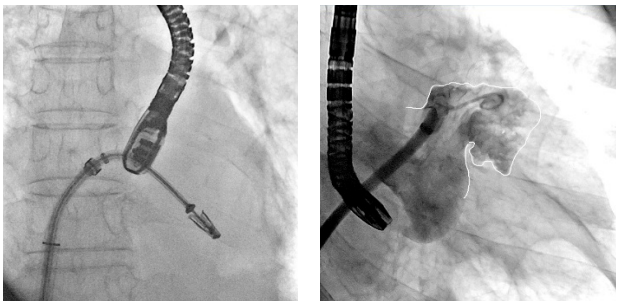

Fig. 10 During left atrial appendage closure, tracing the vessel wall on the monitor improves procedure efficiency.

**EVT Cases**

Important factors in EVT include the range of motion of the C-arm and image construction that takes into account overlap with bone. The long-length imaging function, which acquires images while moving the tabletop and generates a stitched long-length image, is also useful. Trinias Opera supports these requirements through its diverse C-arm positions, SCORE RSM, and SCORE Chase functions.


**Fig. 11** During treatment, the entire lower extremity was acquired using SCORE Chase, enabling pre- and post-procedure comparison.

Because the C-arm offers a wide variety of positions, lower-extremity arteries can also be observed using the biplane system. Trinias Opera's versatility in accommodating a wide range of situations is one of its advantages.

SCORE RSM is, in effect, "movable DSA." It is a tool that does not produce the misregistration that occurs with DSA and that also allows the relationship with bone to be understood. With DA, the densities of trabecular bone and contrast-enhanced vessels are similar, making observation difficult. With DSA, the area covered in a single acquisition is limited, and bony structures are completely subtracted. SCORE RSM is a method that successfully images by combining the advantages of DA and DSA. In the hybrid cathlab, relatively large sheath introducers are often used. SCORE RSM is extremely effective for evaluating complications such as vascular injury caused by the sheath, as well as peripheral blood-flow impairment. SCORE Chase is a function incorporated from Opera onward that enables long-length lower-extremity angiographic data to be stitched together with a single button operation. This function can be used for patient informed consent and report preparation **(Fig. 11)**, allowing the treated lesion to be identified at a glance.

## 4. Conclusion

Trinias Opera, equipped with AI, has the potential to evolve further, and it is a system that inspires anticipation for the future. As in an operatic performance, the cathlab becomes the stage, and through better harmony among physicians and medical staff, it is expected that optimal medical care can be provided to patients.

**Reference**

1) Oshikawa S, et al. Development of AI image processing SCORE Opera for angiography systems using deep learning. Shimadzu Review. 2022;79(1–2):123–128.

Editorial Note

※ The AI technology adopted in Trinias is not a type of AI that repeatedly learns on its own.