Vascular

Voice Control in an Angiography System: Initial Experience with SMART Voice

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1. Introduction

It has been one year since we introduced the angiography system Trinias series with SCORE Opera at our Cardiovascular Center. We have become proficient in the system's functions and have a substantial understanding of its performance. In this paper, I would like to present the details of our experiences, including the initial use of the newly introduced voice recognition-based voice control function and our future prospects.

2. Overview of Trinias series with SCORE Opera

The Trinias series with SCORE Opera (hereafter referred to as Trinias) represents a full model change by the manufacturer for the first time in over a decade, featuring various improvements in design, user interface, and functional details. Firstly, regarding its appearance, the overall design of the C-arm, cable management, and interfaces is simple and modern. To complement this design, we updated the cathlab's walls, ceiling, and floor to a futuristic aesthetic, primarily in white and black **(Fig. 1)**. Additionally, I find the usability of the control module and touch panel at the table side to be highly user-friendly. The integration of the SMART Display in the control room has also enabled efficient space utilization. Furthermore, the application platform SCORE Link, which is centered on the concept of growth, allows for the anticipation of new functions even after the installation.

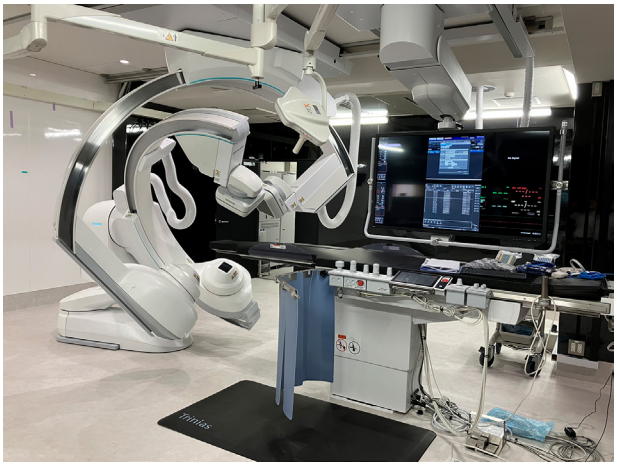

Fig. 1 Biplane system Trinias B8s with SCORE Opera introduced in September 2023.

3. Table Side Control Module

The control desk of the newly introduced system **(Fig. 2)** is designed simply, and I find the touch panel (SMART Touch) to be exceptionally user-friendly. SMART Touch integrated numerous functions, which are clearly categorized into five tabs: Custom, Protocol, Tools, Monitor, and C-arm **(Fig. 3)**. The Custom tab allows for a flexible layout, enabling frequently used functions to be positioned at the top of the screen for one-touch operation. Additionally, functions can be color-coded for easy categorization. While the

Fig. 2 Simple table side control module and touch panel.

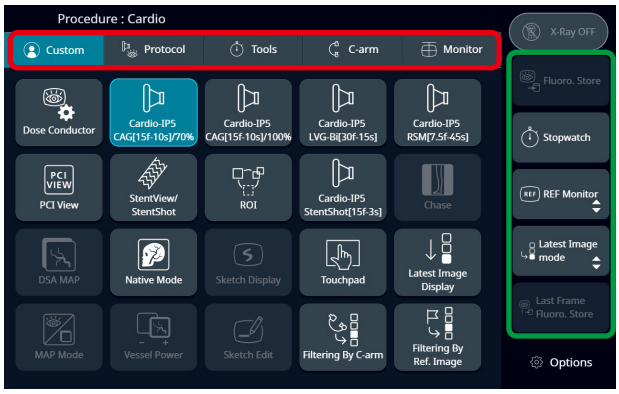

Fig. 3 Screen of SMART Touch (Custom tab). Functions are divided into five tabs (red box). Important operational sections that are always displayed (green box).

button division in **Fig. 3** shows 20 segments, it can be further simplified and reduced, allowing for a customizable layout based on the operator or procedure. The Monitor tab includes a preset section for changing the layout of the large screen monitor (SMART Display) in the examination room and the currently displayed layout area **(Fig. 4)**. We have registered 16 layout presets at our hospital. Even in institutions with multiple operators, each operator can register their preferred layout. Moreover, it is possible to register layouts specific to certain procedures, such as for ablation or lower extremity interventions. Furthermore, images can be easily swapped by touching the laid-out images **(Fig. 5)**. For instance, if one wishes to enlarge the IVUS image, touching the IVUS image and the image to be replaced allows for immediate swapping. This is similarly applicable when there are changes in the electrocardiogram. Traditionally, medical staff would handle these operations, but when communication is not effective or when staff are occupied with other tasks, the operator may feel stressed and raise their voice. An increase in such situations can lead to staff intimidation and

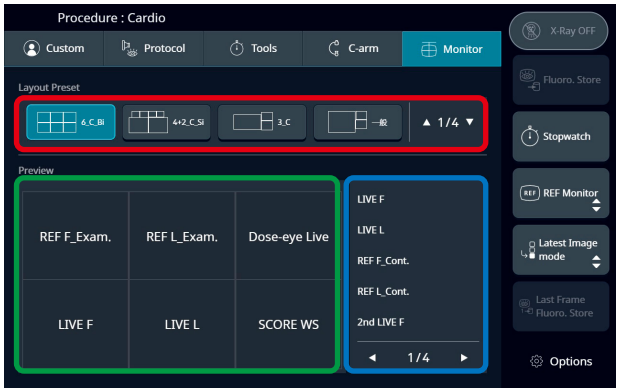

Fig. 4 Screen of SMART Touch (Monitor operation tab). Layout preset section (red box) and currently displayed layout area (green box). List of all input modalities (blue box).

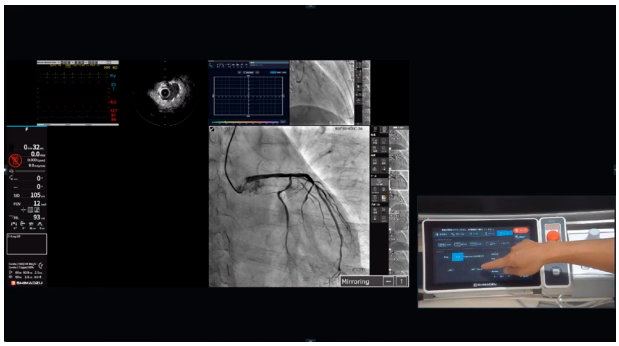

Fig. 5 Ability to freely layout and swap images on the touch panel.

negatively impact the psychological environment of the cathlab. Since SMART Touch allows for easy self-operation, I feel it alleviates the psychological burden on the staff. The C-arm, of course, can still be operated via lever control as before, but by rotating the dial at the lever's end (**Fig. 6**, arrow), the FPD can also be closely positioned. Additionally, the direct memory function (**Fig. 7**) allows for intuitive operation; by simply touching the desired FPD position on the patient illustration displayed on the touch panel and pressing the set key, the C-arm will respond accordingly. The angle memory also includes a sequence mode **(Fig. 8)**, allowing for routine angles to be registered so that after each acquisition, pressing the set key positions the C-arm for the next angle. This function allows for quick acquisition, making CAG more efficient.

Fig. 6 SID operation using a dial lever.

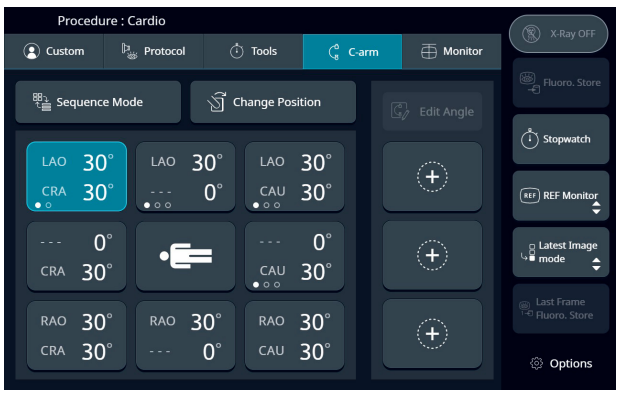

Fig. 7 Direct memory with patient illustration and arm angles.

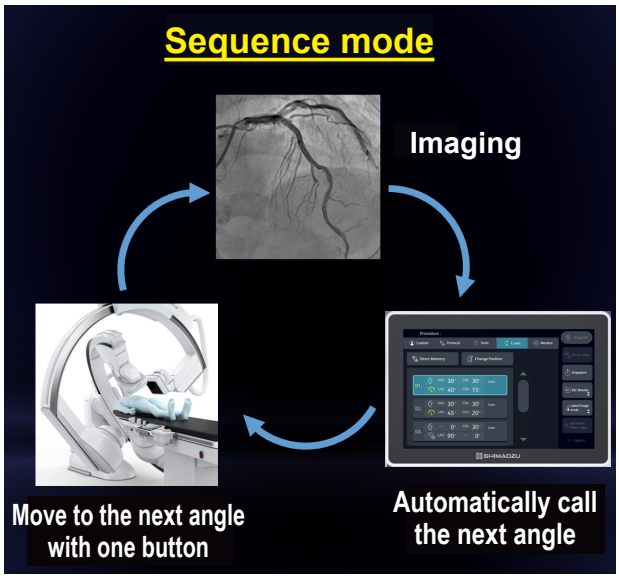

Fig. 8 Flow of sequence mode.

The protocol tab contains settings for fluoroscopy, acquisition conditions, and field of view. The most commonly used feature is adjusting the dose level **(Fig. 9)**. Previously, changing the dose level required requesting staff assistance each time, which was inefficient and made it difficult to control the dose level as desired. With SMART Touch, adjustments can now be made easily at hand, allowing for dose control at the operator's preferred timing. The fluoroscopy dose level offers seven stages, ranging from -3 to +3. Our hospital uses the lowest dose level of -3 (approximately 40% of standard fluoroscopy) by default. However, during complex wiring such as chronic total occlusion (CTO), we may increase the dose level as necessary. The differences in actual dose and image quality are shown in **Fig. 10**. It is evident that even at the -3 level commonly used at our hospital

Fig. 9 Dose level control button.

(**Fig. 10**, left), sufficient image quality is maintained. By utilizing the dose control features of SMART Touch along with the low-dose capabilities of the AI filter, we have been able to perform procedures with an average dose that is approximately half that of previous angiography systems.

4. SMART Dial

Another feature that I find particularly user-friendly is the SMART Dial **(Fig. 11)**. Located next to the touch panel, this lever allows for image control through a single dial operation, enabling the selection of references, playback, pause, and frame advance or rewind simply by turning the dial. In contrast to traditional button operations, which require monitoring multiple buttons for functions such as play, pause, and frame advance, this operation often necessitated assistance from staff. The functionality of the SMART Dial can also be controlled using the voice recognition feature mentioned later.

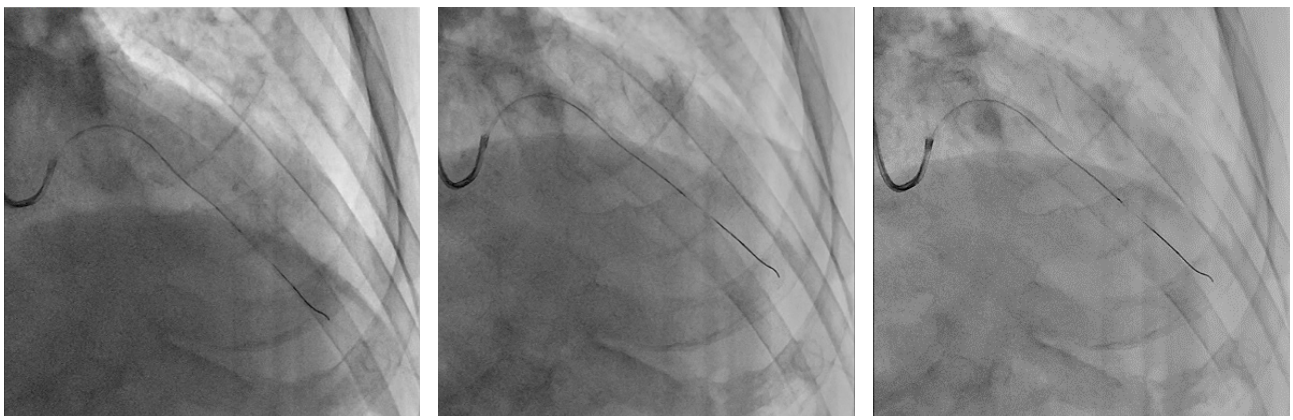

Fig. 10 Fluoroscopy images saved at different dose levels during IVUS (from left: dose level -3, 0, +3). While +3 offers the best image quality, -3 is sufficient for interventional procedures.

Fig. 11 Image control module utilizing a dial.

5. Integrated Control Room Monitor: SMART Display

The control room can be operated with just two 31-inch monitors and optional controllers, a mouse, and a keyboard **(Fig. 12)**. Furthermore, it allows for mouse sharing with up to five external input peripherals such as workstations. This setup avoids the common scenario where multiple mouse devices and keyboards clutter the control room, making it unclear which controls which system, and has received positive feedback from radiological technologists. Additionally, the system can now be easily controlled by a single operator, leading to improved operational efficiency.

Fig. 12 The integration of the monitor system (two 31-inch monitors) has organized the control room and improved space efficiency.

6. SCORE StentShot

SCORE StentShot is a useful application, especially when operators want to check the shape of a stent in more detail. It captures images under the same X-ray conditions as standard acquisition but enhances stent visibility through additive processing **(Fig. 13)**. Notably, this additive processing removes noise components; however, upon confirming with Shimadzu, it was found that noise decreases rapidly within the first two seconds after acquisition (as shown in **Fig. 14**), but the noise reduction effect diminishes beyond this time frame. Therefore, we have configured the StentShot to automatically terminate X-ray exposure after two seconds. This automatic cessation of X-ray exposure helps to avoid unnecessary X-ray dose from overexposure and prevents issues arising from exposure times that are too short to create enhanced stent images. An example where StentShot proved effective is presented here. A case involved the placement of a stent in response to diffuse lesions in the proximal left anterior descending artery (LAD) (**Fig. 15a** ▲). A rare phenomenon occurred where only the proximal of the balloon expanded while the distal remained occluded (**Fig. 15b**) (**Fig. 15c**: StentShot). The balloon was removed, and the non-expanding area was re-expanded using 1.5mm and 2.5mm balloons, followed by placement of the stent using a 3.5mm balloon (**Fig. 15d**: StentShot). This clear visualization of the stent shape enabled successful bailout without the need for IVUS, even in calcified areas.

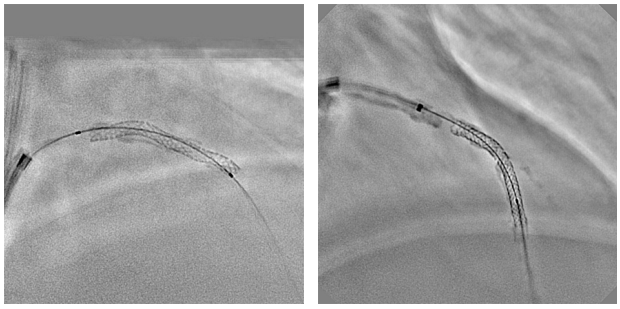

Fig. 13 Clear visualization of stent shape.

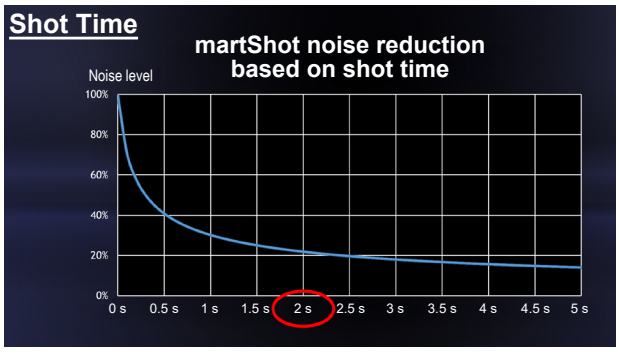

Fig. 14 Noise components decrease rapidly within the first two seconds after acquisition.

7. Voice Recognition Function: SMART Voice

We began evaluating the voice recognition function, SMART Voice, in the summer of 2024. By speaking the wake-up word "Trinias," the system enters

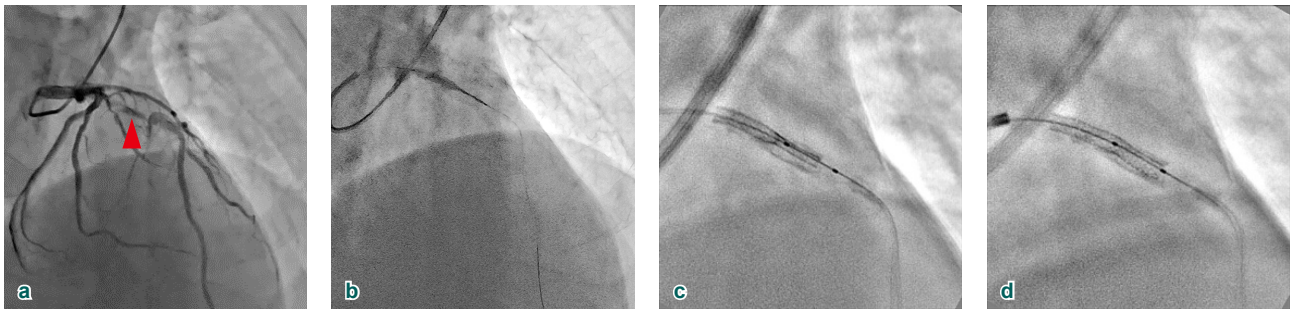

Fig. 15 Cases where StentShot was useful during post-dilation: a, b, c, d.

voice recognition mode, displaying "Listening." When a designated function or operation name is spoken, the corresponding function is activated automatically, eliminating the need to press buttons or request assistance from staff. **Fig. 16** shows the screen during fluoroscopy store when performing a CAG of the LAD. Upon saying 'Trinias,' the voice recognition mode activates, and when 'Save' is spoken, the fluoroscopic dynamic images are smoothly stored. Once saved, the display shows "Saved," confirming the successful store. **Fig. 17** shows the use of SMART Voice for "Fluoroscopy Save" during SCORE StentShot. In this scene, the non-compliant balloon is used to re-expand the insufficiently expanded section of the stent. Similarly, speaking "Trinias" followed by "StentShot" transitions the system to StentShot mode, allowing operators to see stent enhanced images with just a footswitch press. This function can also be utilized for reference image operation. However, I personally recognize the excellent operability of the previously mentioned SMART Dial and have not relied heavily on SMART Voice for image operations. My initial impressions of SMART Voice are as follows:

- The accuracy and completeness of the voice recognition are remarkably high.
- It further reduces the workload for the 2nd operator.
- Even when 2nd operator or staff are inexperienced or busy, SMART Voice provides support.
- I look forward to future enhancements of this function.

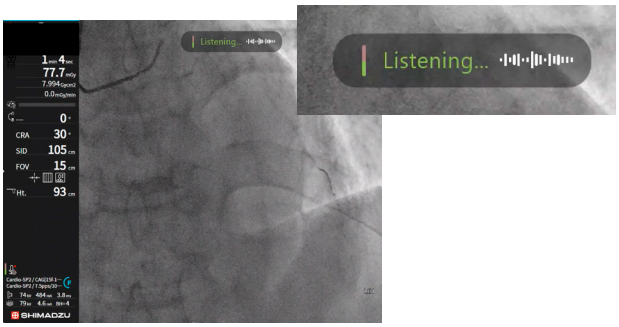

Fig. 16 a Screen when "Trinias" is spoken.

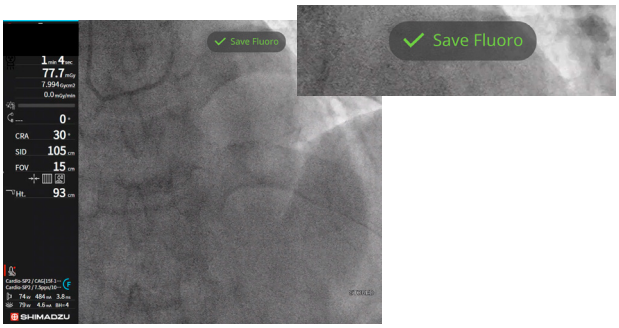

Fig. 16 b When saving is complete, the screen displays "Saved," confirming the execution of the storage.

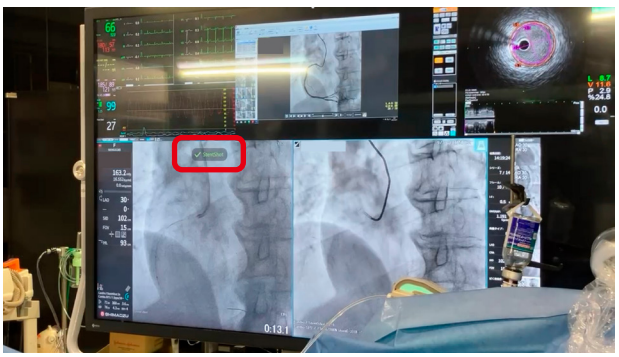

Fig. 17 Scene when using SMART Voice with StentShot.

8. Conclusion

This paper introduced the practical use of Trinias in our hospital. In particular, the operation via voice recognition, such as SMART Voice, holds great potential. This technology could enhance the efficiency of the cathlab by improving operations involving hardware like the C-arm, imaging protocols, monitor layouts, and system settings. We greatly anticipate further advancements in this area and hope Shimadzu continues to strive for improvement.