PCI with the SCORE StentView Application for the Trinias Angiography System

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1. Introduction

Mimihara General Hospital is located in the middle of Sakai City, Osaka Prefecture. The hospital is responsible for acute medical care in the local area and receives around 3,800 emergency transport cases per year. The hospital has 386 beds, including 4 ICU beds and 3 CCU beds, and is accredited as a training facility by the Japanese Society of Internal Medicine, the Japanese Circulation Society, the Japanese Association of Cardiovascular Intervention and Therapeutics (CVIT), and the Japanese Heart Rhythm Society. The hospital has 5 cardiologists (of which 2 are doctors in training) and 1 cardiovascular surgeon active in cardiovascular medicine, with 311 PCIs and 50 cardiovascular surgical procedures performed in 2012.

In addition to catheterization for ischemic heart disease such as PCI or rotablator, the hospital is able to perform a wide range of cardiovascular interventions such as ablation for arrhythmia, and biventricular pacing therapy for serious heart failure. While larger hospitals have more hospital staff and are more specialized in certain areas of cardiovascular medicine, though each doctor at Mimihara General Hospital has their own particular field of expertise, we aim to perform as a medical team capable of responding to a wide range of conditions and not become entrenched in one specialist field.

2. System Outline

A photograph of the Trinias F8 package (Shimadzu) introduced to the hospital is shown in **Fig. 1**, and its main specifications are shown in **Table 1**.

The size of the FPD used with the system is 8 inches, and as mentioned previously, the system is used in a wide range of cardiovascular procedures mainly for PCI. The C-arm is particularly easy to manipulate and the "DirectMemory" function that remembers C-arm angles is designed to be used intuitively and easily. A 56-inch large SMART display has been placed in the catheterization room as a viewing monitor capable of displaying angiography images, electrocardiograms, IVUS, OCT, and PACS images with a freely adjustable on-screen layout. Fluoroscopy images can be viewed at sizes larger than was previously possible, and images can be viewed with ease during PCI.

At Mimihara General Hospital, we aim to reduce exposure dose during procedures and almost always use a fluoroscopy rate of 7.5 pps. We appreciate the convenience of being able to manipulate the reference monitor and use it for cine playback even during ongoing fluoroscopy and radiography. The Trinias angiography system allows the doctor to perform fluoroscopy or radiography without concern while the X-ray technologist organizes reference images in the control room, and for the doctor to undertake procedures while simultaneously viewing cine on the reference monitor. This feature is not available with other manufacturers' systems and helps greatly in reducing procedure times.

Fig. 1 Trinias F8 Package

FPD	8 × 8 inch
C-Arm	Floor-mounted, 6-axis type (Single plane system)
Monitor	SMART Display (56-inch monitor screen, 8-channel simultaneous output type)
X-Ray Tube	3.0 MHU liquid bearing type
Image Processing	SCORE PRO Multi frequency, low noise image processing SCORE RSM Frequency subtraction SCORE StentView Real-time display of stent in a fixed position, stent expansion and addition

Table 1 Trinias F8 Package Main Specifications

3. SCORE StentView Case Overview

SCORE StentView (hereinafter "StentView") is a tool designed to support PCI procedures by showing an enhanced view of the stent, including second-generation thin stents that are difficult to visualize. StentView makes it easy to determine the correct position of the stent or of the balloon when placing partially overlapping stents or re-expanding a stent, and in addition can be used to evaluate the degree of stent expansion and confirm the degree to which a strut has opened when expanding a lateral branch. While other manufacturers' angiography systems include stent enhancement tools, they only display the enhanced image of the stent with a time lag after radiography and image processing. Shimadzu's StentView is able to display images in real time during ongoing radiography and follow balloon movement in real time, which makes it possible to position a balloon while simultaneously viewing enhanced images of the stent.

One precaution when using StentView is that when detecting balloon markers and displaying a fixed view of the stent area, on rare occasions the markers are not recognized correctly. When this occurs, a correct view can be obtained by changing the direction of radiography or by adding filters to increase the precision of detection.

Example uses of StentView at Mimihara General Hospital are shown in Table 2, and relevant case examples are introduced below.

SCORE StentView Use Cases

- Determining stent position (checking the degree of overlap between overlapping stents)
- Positioning a balloon when re-expanding a stent
- Evaluating the degree of stent expansion and indentation

Also

- Checking stent expansion and the position of the guide wire in lateral branches
- Determining stent fracture

Table 2

Case Example 1 (Fig. 2, 3, and 4)

Using StentView for Overlapping Stents

Observations	LAD#6 (75 %), #7 (90 %), #8 (90 %) Stent already in place at #6
Site of Treatment	#7–8 PROMUS Element plus (2.25 × 32 mm) in place #6–7 PROMUS Element plus (3.0 × 24 mm) in place
Summary	After placing a stent at #7–8, StentView was used during placement of the second stent in #6–7 to overlap with both the previous stents. StentView was useful for checking the position of the distal and proximal ends of the stents.

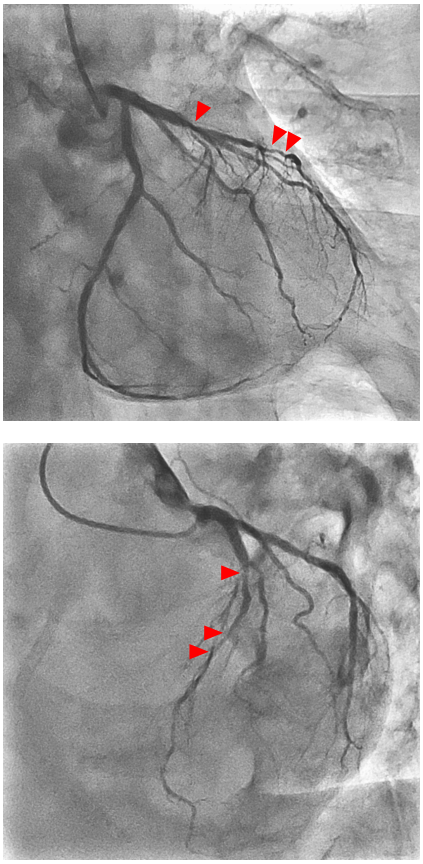

Fig. 2 CAG Before the Procedure

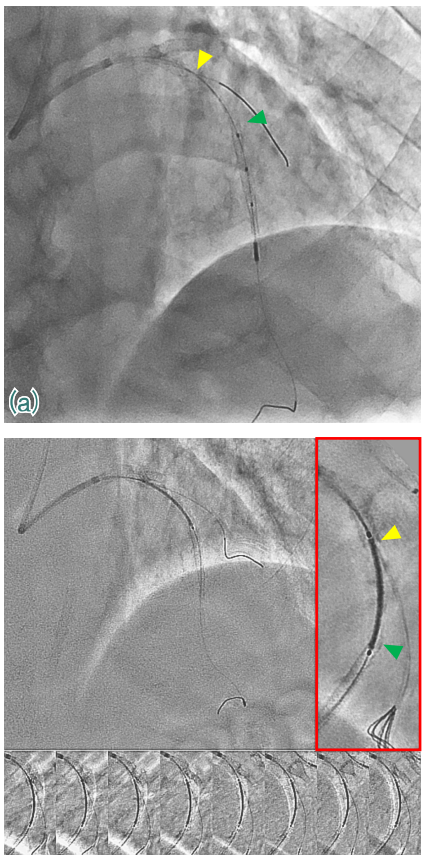

Fig. 3 (a) Distal part of previously placed stent (#6) (yellow arrow). Proximal part of stent placed on this occasion (#7–8) (green arrow). Edge of #6 stent particularly difficult to ascertain
(b) Using StentView to determine the position of overlap when placing one more stent at #6–7 (top right of image). Both stent edges are depicted clearly.

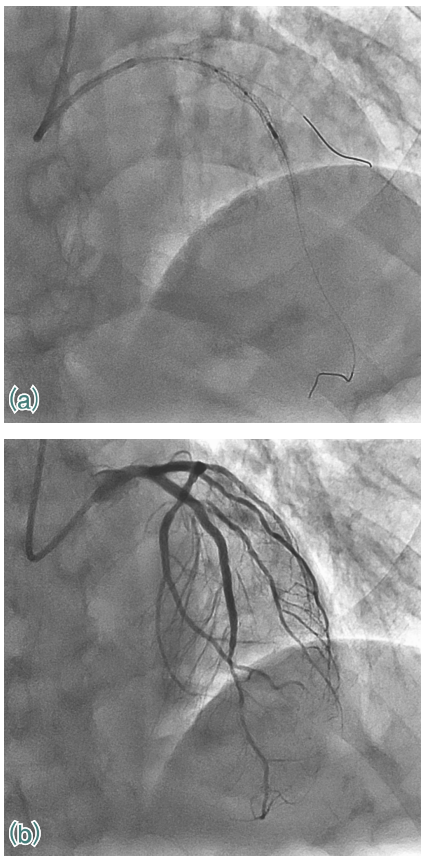

Fig. 4 (a) Performing IVUS After the Procedure
(b) CAG After the Procedure

Case Example 2 (Fig. 5, 6, 7, and 8)

Using StentView to Check Wire Recrossing for KBT

Observations	LAD#6 (90 %), #9 (90 %). Stent already in place at LCX#11
Site of Treatment	#6 Resolute Integrity (3.0 × 26 mm) in place #9 POBA
Summary	The LCX was jailed and a stent was placed at #6. A LCX guide wire was recrossed from the strut to perform KBT. StentView was useful for checking proper recrossing.

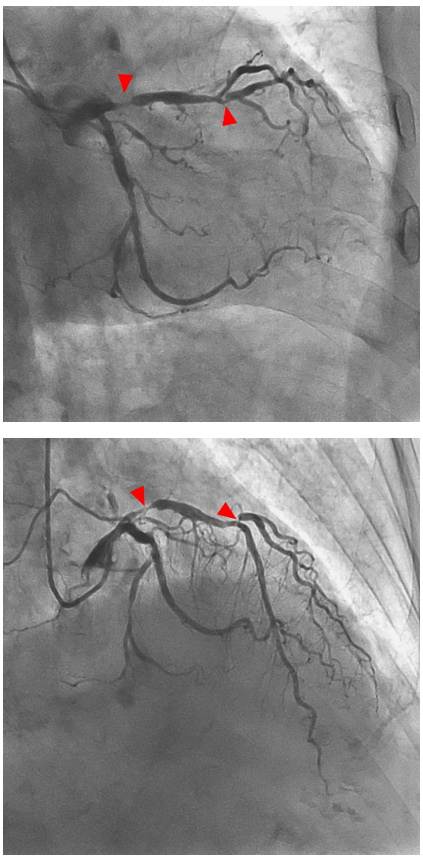

Fig. 5 CAG Before the Procedure

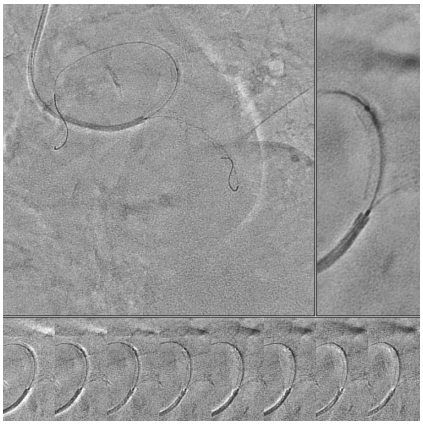

Fig. 6 Stent Placement from LMT Across #6. StentView used to determine the position for re-expansion

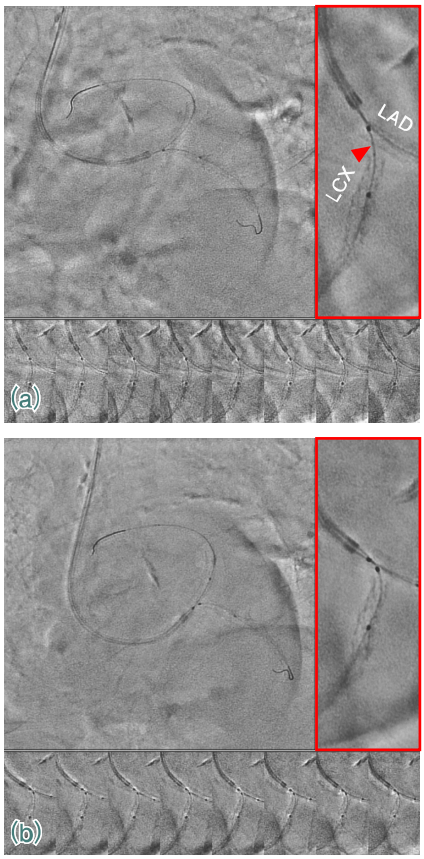

Fig. 7 (a) Confirming the wire had recrossed properly within the stent strut placed at #6 in Fig. 6. Also, using StentView to confirm the position before using the balloon to expand the strut at the jailed location
(b) Using StentView to confirm positioning during kissing balloon inflation

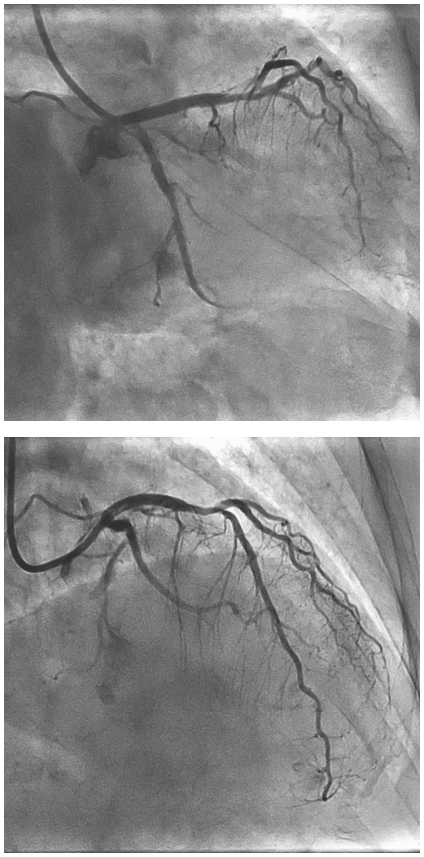

Fig. 8 CAG After the Procedure

Case Example 3 (Fig. 9, 10, and 11)

Using StentView to Confirm Whether the Stent Has Deformed Due to the Effects of Strut Expansion During KBT

Observations	LAD#7 (90 %), #9 (99 %)
Site of Treatment	#6-7 PROMUS Element Plus (2.5 × 38 mm) #9 Prox. PROMUS Element Plus (2.5 × 16 mm) #9 Mid. PROMUS Element Plus (2.5 × 32 mm)
Summary	After stent placement at #9 Mid., dissection was observed at #9 Prox., so a stent was placed to protrude slightly into the main LAD. Then a stent was placed over #6–7 to span across #9, and the strut was expanded. StentView was used during this procedure to check there was no deformation of the stent (in particular, there was no deformation due to stretching into the strut on the opposite side).

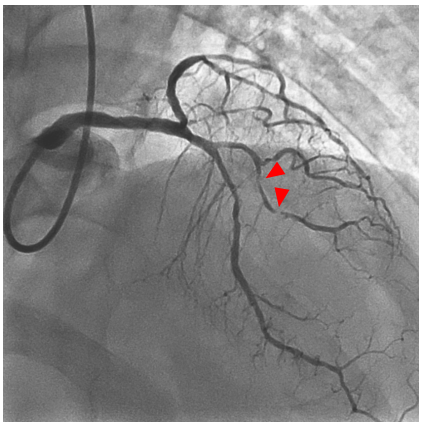

Fig. 9 CAG Before the Procedure

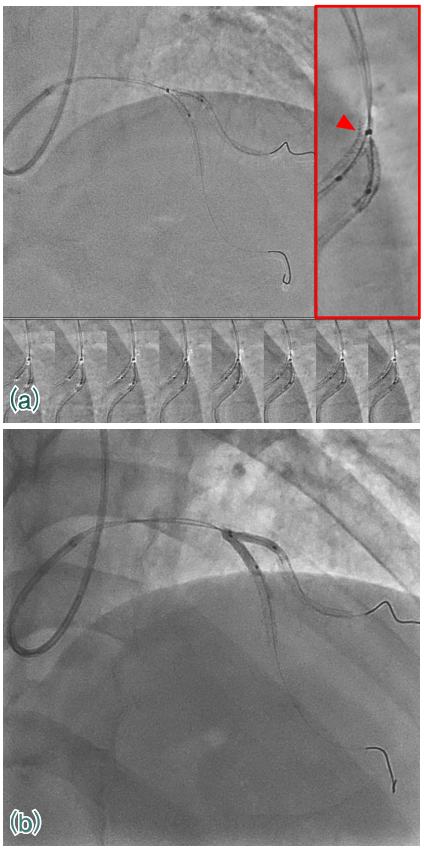

Fig. 10 (a) Using StentView to confirm there was no deformation by extension into the opposite side (red arrow) after the strut was expanded, and to check the positioning of KBT
(b) Radiography for confirmation during KBT

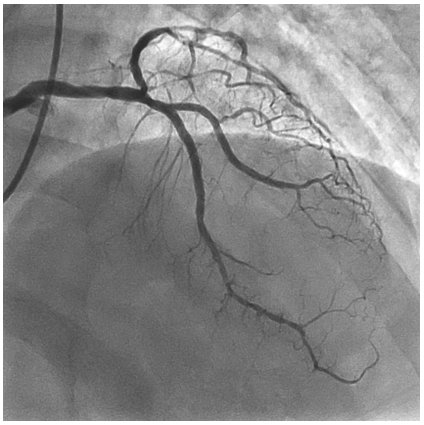

Fig. 11 CAG After the Procedure

Case Example 4 (Fig. 12)

Using StentView to Check for Stent Fracture (using IVUS marker)

Observations	RCA#2 (inside-stent restenosis fracture 90 % with PPS), #3 (90 %), #4PL (99 %)
Summary	StentView with IVUS markers was used to check fracture at #2. Shape of fracture was depicted clearly. Automatic detection of balloon markers is an important feature of the StentView mechanism, but IVUS markers can also be used in place of balloon markers.

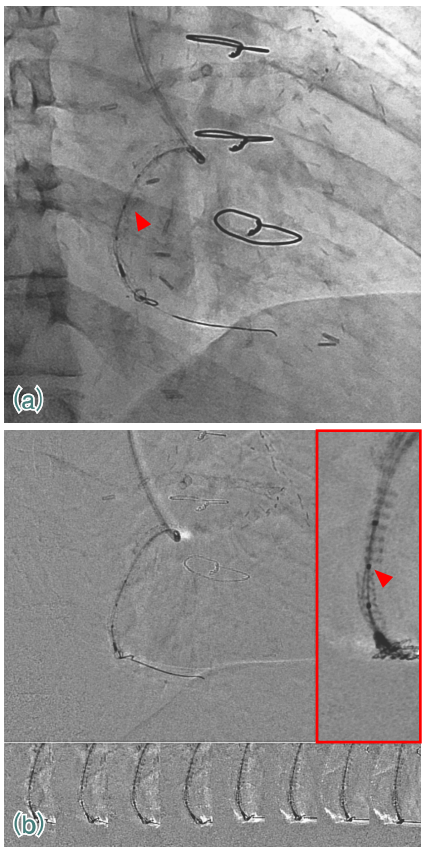

Fig. 12 (a) Radiography image during IVUS. Difficult to gain a complete idea of the shape and location of the fracture
(b) Using StentView with IVUS markers. Shape and location of fracture is clear.

4. Summary

For the operator, it is important that an angiography system is able to take high quality images, but from the perspective of the patient, it is also very important that exposure dose is reduced and procedure duration is shortened. With reference images that can be manipulated freely, and SCORE StentView and SCORE RSM tools used to support procedures, the Trinias angiography system accommodates the needs of both operators and patients. We intend to continue to collaborate with X-ray technologists and paramedical staff to provide safe and minimally invasive procedures.