Vascular

Development of the Trinias™ Series Biplane Angiography System

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1. Introduction

Following the release of single-plane Trinias series angiography systems with a SCORE™ Opera image processing engine in 2022, we launched a biplane model in April 2023 **(Fig. 1)**. While maintaining the three core design concepts (ALARA, lean, and sustainable design) **(Fig. 2)** aimed at addressing current and future challenges in clinical practice, the biplane model was developed to specifically resolve issues unique to biplane systems. This article describes those challenges and the corresponding solutions.

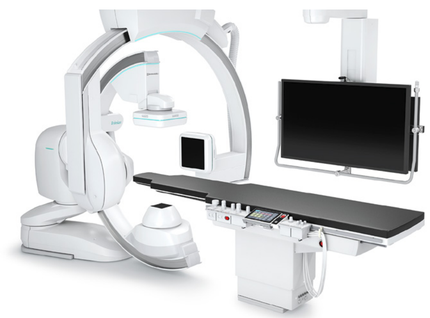

Fig. 1 Trinias B12s with SCORE™ Opera™

Fig. 2 Design Concepts

2. Challenges in Biplane Systems

Biplane systems, which enable imaging from two directions with a single injection of contrast media, are highly effective in reducing the amount of contrast media used and shortening procedure times. Furthermore, they are adaptable for multipurpose use across multiple medical departments, making them increasingly in demand as the scope of minimally invasive treatments expands. However, the simultaneous and complex movements of two C-arms make operation more cumbersome compared to single-plane systems, necessitating an intuitive and user-friendly interface. Biplane systems are frequently employed in complex cases involving higher radiation doses, making it essential to provide a visual display of the current dose in real time.
Additionally, against the backdrop of workstyle reforms in healthcare and stricter radiation dose management, there is a growing demand for systems that offer seamless workflows, minimize operator stress even for new users, and promote awareness of radiation exposure.

3. Key Features

The Trinias series incorporates numerous features designed to address such challenges. Below, we highlight three key functionalities.

3.1 Intuitive Angle Setting with Direct Memory and Sequence Modes

In our angiography systems, the intuitive Direct Memory angle-setting functionality has been integrated into the SMART Touch bedside touch panel control modules of Trinias series systems with SCORE Opera, replacing the physical buttons provided in previous systems. This allows both frontal and lateral arm angles to be intuitively checked and selected with a single button on the SMART Touch screen, simplifying the somewhat complex operations inherent in biplane systems **(Fig. 3)**.
Additionally, a Sequence Mode has been introduced that enables the registration of imaging sequences in Direct Memory functionality. In this mode, when the SET key is pressed to complete C-arm positioning and initiate X-ray exposure, the next angle is selected automatically from memory **(Fig. 4)**. Thus,

even new users can perform routine examinations using minimal operations.

Fig. 3 Example of Direct Memory for Biplane Systems

Fig. 4 a) After Pressing the SET Key

Fig. 4 b) The System Automatically Moves to the Next Angle after Exposure

3.2 Enables Switching between Lateral Arm Settings Depending on the Application

With increasing demand for multipurpose use, the orientation of the lateral arm needs to be adjusted according to the purpose of treatment. In cardiovascular interventions for instance, the lateral arm's X-ray tube is typically positioned on the patient's right side and the FPD (flat-panel detector) on the left **(Fig. 5)**. In neurovascular interventions, the tube is often on the left and the FPD on the right **(Fig. 6)**. The required orientation of the lateral arm varies by specialty.

In B12s/8s model Trinias series systems with SCORE Opera, the lateral arm orientation can be adjusted as needed based on the medical specialty and treatment. While orientation adjustment was possible in previous systems, the procedure was more complex. This system simplifies the steps and displays the procedure on the SMART Touch interface, enabling smooth and efficient preparation.

Fig. 5 For Cardiovascular Interventions, the Lateral X-Ray Tube is on the Right Side of the Patient.

Fig. 6 For Neurovascular Interventions, the Lateral X-Ray Tube is on the Left Side of the Patient.

3.3 Rapid C-Arm Positioning

Improved C-arm movement speed is a significant feature of B12s/8s Trinias series systems with SCORE Opera. The time required to move from the parked position **(Fig. 7)** to the operable head position **(Fig. 8)** has been reduced by more than 50%*, minimizing waiting time for medical personnel. Additionally, the rotation speed of the C-arm has been increased by up to 1.6 times*. These improvements reduce the time needed for C-arm setup, which is helpful for achieving uninterrupted procedures and minimizing waiting time.

*Compared to our previous models

Fig. 7 Parked Position

Fig. 8 Operable Head (Home) Position

3.4 Real-Time Radiation Dose Awareness with Dose-Eye Live

Dose-Eye Live is a dose mapping application that visually displays the maximum entrance surface dose in real time during procedures. The total dose for the frontal and lateral planes is shown color-coded. Specifically, the dose map, based on the C-arm angles, is updated in real time according to parameters such as the C-arm angle during exposure, table position, field size, and SID (source-to-image distance) **(Fig. 9)**. High-dose regions are highlighted in warning colors, such as red and purple, allowing users to intuitively identify and avoid high-dose angles. This feature enhances awareness of radiation dose during procedures.

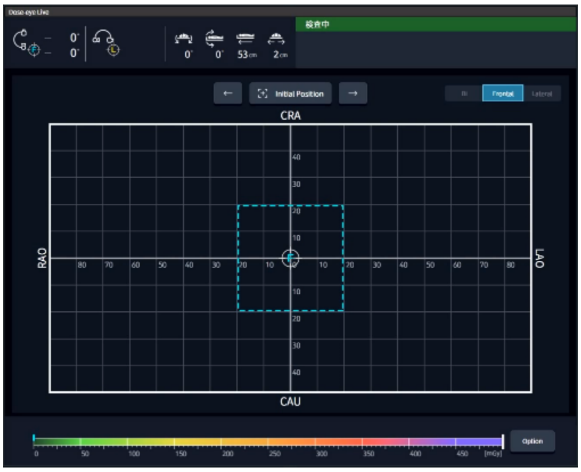

Fig. 9 a) Dose Map before Exposure in a Single Plane System
The map is based on the C-arm angle, with the exposure range in the current geometry indicated by dashed lines.

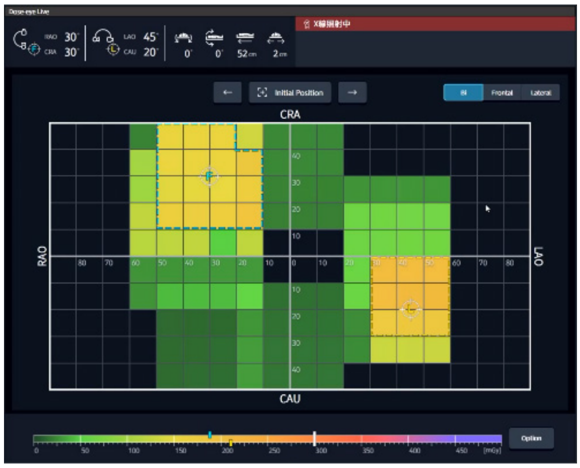

Fig. 9 b) Dose Map in a Biplane System
The angled regions of exposure are color-coded. (This example is from an experimental X-ray exposure conducted in our showroom.) The dashed lines represent the exposure range.

4. Conclusion

The Trinias series with SCORE Opera biplane system was developed with the aim of addressing the challenges faced by all those involved in interventional procedures. We hope that this system will continue to grow and support medical professionals. In conclusion, we extend our heartfelt gratitude to all the physicians and healthcare professionals who contributed to the development of this system.

SCORE stands for Shimadzu Challenge Of Revolution.
SMART stands for Shimadzu Makes Advanced Remarkable Technology.