Vascular

Approach for Crossover Interventional Procedures Using 3D Imaging —Neurosurgery

Trinias Performance in Coil Embolization for Intracranial Aneurysm

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1. Overview

Kozoji New Town was developed as a commuter town of Nagoya City and stands alongside Tama New Town and Senri New Town as one of the three major “new town” development projects in Japan. Nagoya Tokushukai General Hospital was opened adjacent to Kozoji New Town in June 1986. As a core hospital with 350 beds, it is the 16th hospital opened by the Tokushukai Medical Group and their first hospital in the Chubu region of Japan **(Fig. 1)**. The Department of Neurosurgery plays an important role in providing medical care for stroke syndrome, which can justifiably be called a national affliction, for the increasingly elderly residents of Kozoji New Town.

Our department provides surgical treatments for a variety of cerebrovascular disorders, but due to the recent trend for minimally invasive surgery that places a smaller burden on the patient, we are seeing an increasing shift in emphasis away from open surgery and towards endovascular therapy.

Given this trend, in addition to our Hybrid Operating Room and First Catheterization Room, in May 2019, we also procured a Shimadzu Trinias B12 unity edition angiography system (hereinafter called as “Trinias unity edition”) for our Second Catheterization Room.

Our department started using Trinias unity edition in May 2019 and has since used it to treat a variety of cases including coil embolization for intracranial aneurysm, embolization for AVF and AVM, embolization of tumor feeding vessels, and carotid artery stenting (CAS) for carotid artery stenosis.

Of these endovascular interventions, this article reports on our experiences using Trinias unity edition for coil embolization for intracranial aneurysm.

Fig.1 Nagoya Tokushukai General Hospital
Relocated to a new site in April 2014

2. Trinias Performance in Coil Embolization for Intracranial Aneurysm

2.1 SCORE PRO Advance

When coil embolization first started being used to treat intracranial aneurysms, cases that required angioplasty such as wide-neck aneurysms and fusiform aneurysms could still often only be treated by craniotomy and clipping surgery. However, thanks to balloon-assisted coiling and stent-assisted coiling, intracranial aneurysms previously only treatable by clipping surgery can now be treated by coil embolization.

Compared to coil embolization performed using simple techniques, balloon-assisted and stent-assisted coil embolization brings a number of noted issues, including difficulty visualizing the complex intermingling between the coil-delivering microcatheter and stent- or balloon-delivering catheter, and difficulty verifying balloon dilation or stent expansion.

Trinias unity edition comes equipped with SCORE PRO Advance that provides motion-tracking noise reduction, in addition to high-speed image processing that was developed based on the key concepts of a lower X-ray dose and high image quality. By using SCORE PRO Advance, Trinias unity edition ensures high visibility of medical devices during coil embolization procedures.

Here we present the case of a 67-year-old woman who was discovered incidentally to have an unruptured intracranial aneurysm in the parasellar region of the right internal carotid (IC) artery during a medical checkup of the brain. We identified a wide-necked

aneurysm with a 5-mm neck width and 6-mm dome and performed balloon-assisted coil embolization.
After placing a guiding catheter (8Fr Optimo, Tokai Medical Products) in the internal carotid artery and using remodeling technique with a SHOURYU HR balloon catheter (Kaneka), coil embolization for the intracranial aneurysm was completed without issue by inserting an AXIUM coil (Stryker) through SL-10 (Stryker) into the aneurysm.
Trinias unity edition carries out motion tracking noise reduction by detecting and aligning subject movement for specific regions within time-sequential moving images to reduce noise without causing after-image. This motion tracking noise reduction enables us to verify with extreme clarity the expanded balloon, balloon marker, and 1st and 2nd microcatheter markers, even in the parasellar region with its complex bone structure and large volume of air **(Fig. 2)**.
Furthermore, though difficult to see in still images, Trinias unity edition keeps catheter after-image caused by vessel pulsating to a minimum, thereby allowing us to recognize even minute catheter movements within the aneurysm that are caused by balloon inflation and deflation.

2.2 FluoroMAP Function

The next case is a 44-year-old woman with a ruptured aneurysm in the parasellar region of her right internal carotid artery caused by a subarachnoid hemorrhage.
The aneurysm neck width was 2 mm and the long and short axes of the aneurysm dome were 4 mm and 2 mm, respectively. Similar to the previous case, we chose to perform balloon-assisted coil embolization.
When a relatively small aneurysm is treated by coil embolization, proper care and attention are needed to avoid the coil escaping from aneurysm. However, for aneurysms in this region, the surrounding bone structure and air in the nasal sinus and petrous bone make it difficult to ascertain the location of the catheter tip, markers, the state of the coil, and balloon expansion, which causes substantial anxiety during coil insertion over whether the coil has NOT escaped from the aneurysm.
Trinias unity edition comes with a range of roadmap functions. The FluoroMAP function substantially improves device visibility in the roadmap by applying a subtraction processing to fluoroscopic images and using the resulting image as a MAP image.
The FluoroMAP function images with the bone subtracted from the image, reducing significantly the issues associated with device visualization **(Fig. 3)**.

2.3 SCORE 3D

Trinias unity edition can perform 3D imaging by C-arm rotation speed at 60°/sec and can display high-definition 3D images just 15 seconds after image acquisition.
In a final case, a patient suffered regrowth and rupture of an aneurysm after initial coil embolization, but using high-definition 3D images enabled us to perform an additional and successful coil embolization.
The 40-year-old man underwent coil embolization at our hospital for subarachnoid hemorrhage associated with rupture of the anterior communicating artery and was discharged to home for outpatient follow-up with a modified Rankin scale (mRS) of 0.
Examinations performed during follow up revealed blood flow within the aneurysm due to aneurysm growth, and the patient was admitted to undergo an additional coil embolization.
Upon acquiring a 3D image from the left internal carotid artery, we confirmed a free space in the dorsal wall of the aneurysm and blood inflow associated with aneurysm growth. A SCORE 3D workstation was used to apply “see-through processing” to the blood vessels, determine in detail the relationship between the free space and parent blood vessel, then use fusion image of fluoroscopy images and 3D image to carefully apply a coil to the free space and perform a

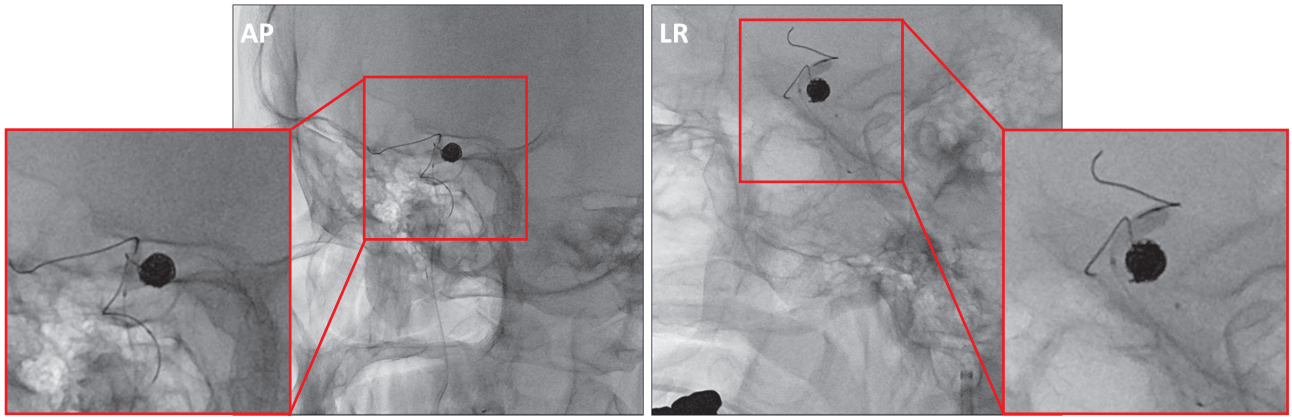

Fig.2 Performing balloon-assisted coil embolization for an unruptured intracranial aneurysm in the parasellar region of the right ICA

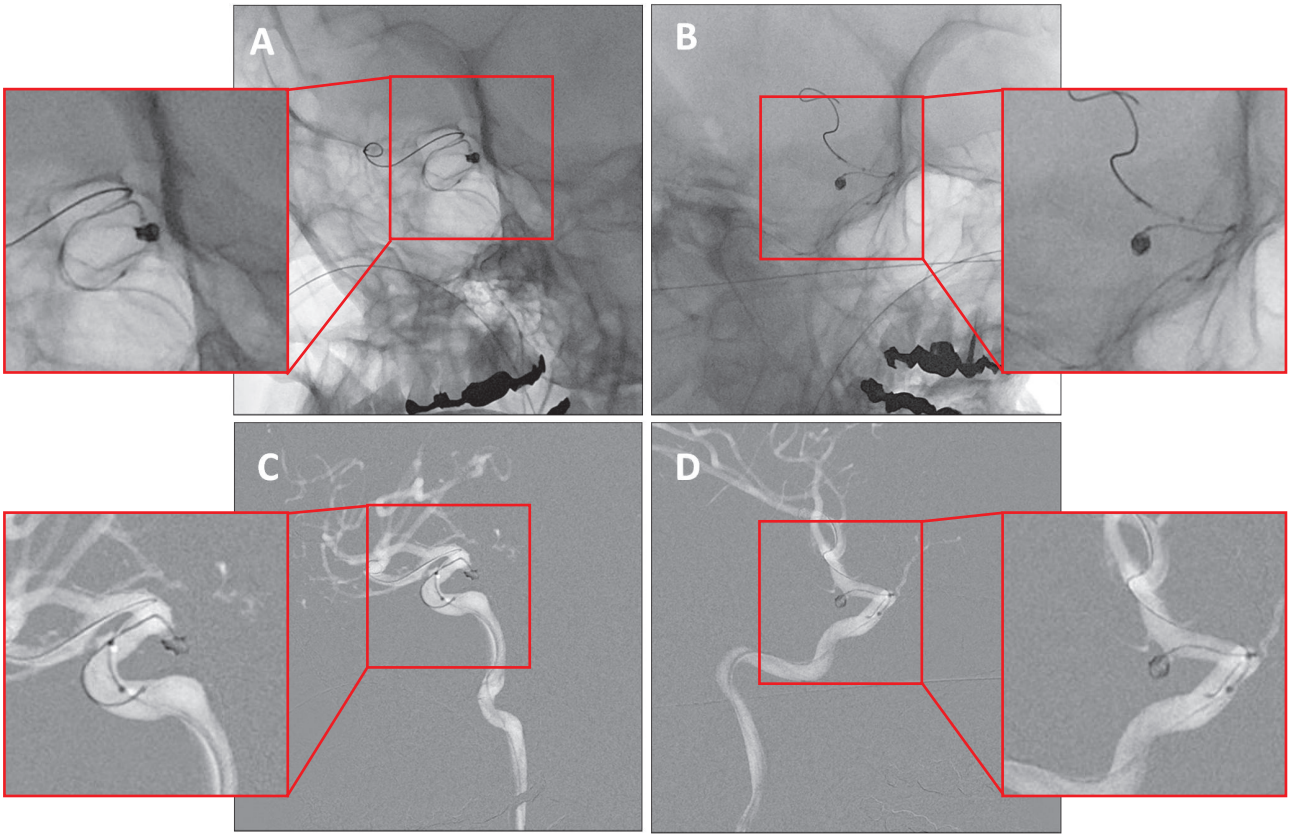

Fig.3 Performing balloon-assisted coil embolization for a ruptured intracranial aneurysm in the parasellar region of the right ICA
A, B: Original images
C, D: Images with bones removed by FluoroMAP function

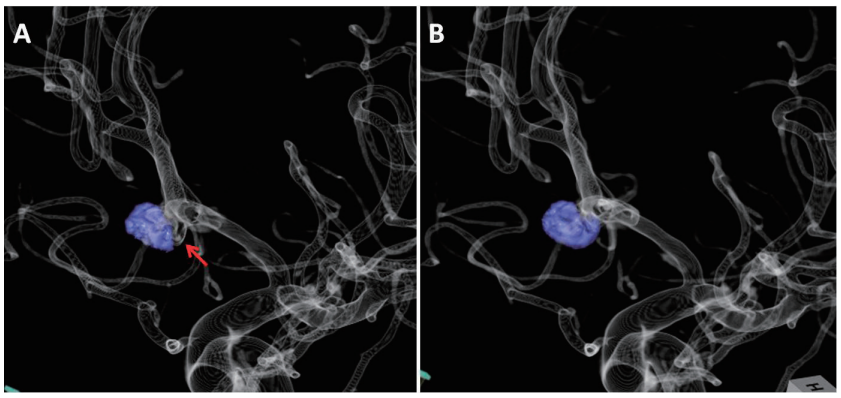

Fig.4 SCORE 3D workstation images of anterior communicating artery intracranial aneurysm
Performing an additional coil embolization for aneurysm regrowth after performing an initial coil embolization for a ruptured communicating artery.
A: Before the additional coil; space caused by aneurysm regrowth (white arrow)
B: After the additional coil

successful coil embolization **(Fig. 4)**.
As operators, we are very grateful for this ability to create high-definition 3D images by a single action in a short period of time, as it eliminates the need to wait for images during procedures and helps us to perform procedures with reduced stress.

3. Future Prospects

With a variety of different devices being developed for neurointerventional treatment, medical care is likely to continue its trend away from open surgery towards minimally invasive endovascular therapy. This will require medical institutions to update their medical devices and adopt new operatinal methods, and fully featured hardware will also be essential to make full use of the new equipment and practices. In this respect, we anticipate Trinias unity edition will play a major role at our hospital for years to come as essential hardware that supports endovascular therapy.