Special column

Challenging of contrast agent-free endovascular treatment using 3D imaging

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Introduction

With advances in devices and techniques, the success rates of percutaneous coronary intervention (PCI) and endovascular treatment (EVT) remarkablly increased. This increased success has facilitated the pursuit of less invasive procedures, such lower dose of contrast agent, lower exposure, and shorter procedure time. Taking advantage of intravascular imaging techniques such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT)/optical frequency domain imaging (OFDI), we are tring to perform accurate and less invasive procedure. When considering less invasive precedures, the role of the angiographic apparatus is significant. With regard to EVT for peripheral arterial disease, in particular, we suggest that the Trinias (Shimadzu Corporation) with the SCORE Navi + Plus is very useful. This is an attached application designed for incorporating preoperative 3D computed

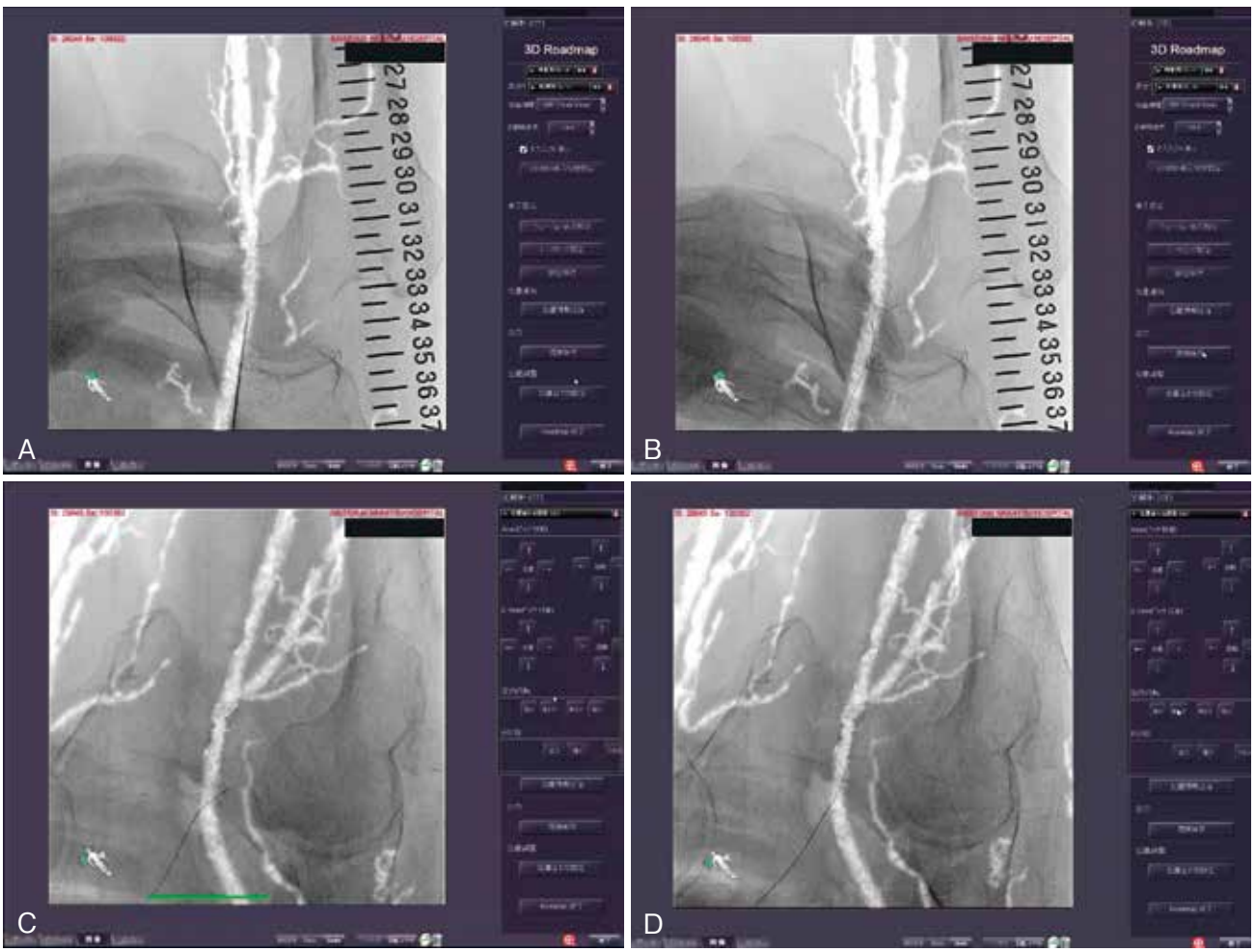

Fig. 1. Case 1

Fig. 2. **Case 2**

tomography（CT）images and angiograms. We describe three cases that the SCORE Navi + Plus was useful reducing or eliminating the contrast agent.

Fig. 3. Case 3

1. Case report

Case 1 (Fig. 1)

Antegrade puncture of the common femoral artery, which is performed during EVT for the superficial femoral artery or a below-the-knee artery, is more difficult and more likely to cause complications than retrograde puncture performed during the usual cardiac catheterization. The patient with critical limb ischemia underwent EVT for below-the-knee artery stenosis. The common femoral artery was punctured at the center of the femoral head, using the SCORE Navi + Plus (Fig. 1-A). The guidewire was erroneously advanced into a probable side branch, but the site where the deviation began was unclear (Fig. 1-B). Therefore, the C-arm was rotated by 30 degrees toward the punctured limb. Because the SCORE Navi + Plus assembles 3D images, the angle of the C-arm is

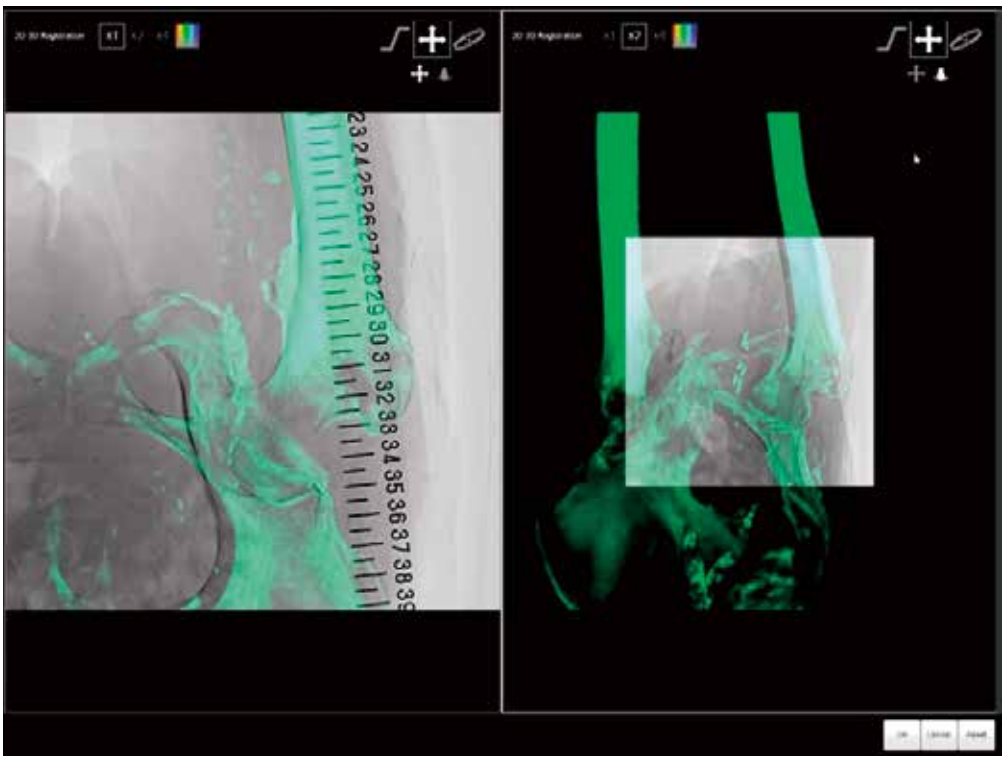

Fig. 4. **A screen at the time of co-registration (SCORE Navi+Plus)**
Green：Preoperative CT image
Gray：Fluoroscopic image

adjustable. The SCORE Navi + Plus allowed us to discover that the guidewire entered into a small side branch originating from the posterior surface of the common femoral artery (Fig. 1-C). We pulled back the guidewire slowly to the main trunk of the common femoral artery while viewing the screen, and successfully advanced the wire to the trunk by directing the wire tip toward the anterior surface (Fig. 1-D). This was a case of a successful antegrade puncture of the common femoral artery, in which the use of SCORE Navi + Plus was effective.

Case 2 (Fig. 2)

The second case was patient with intermittent claudication. He had a history of aortoiliac bypass graft surgery. CT angiography revealed severe stenosis of native external iliac artery and EVT was scheduled. However, skin rashes appeared the day after CT angiography, strongly suggesting an allergic reaction to the contrast agent. Therefore, we decided to perform EVT without using contrast agent, using the SCORE Navi + Plus and IVUS. Under the guid-ance of the SCORE Navi + Plus, the common femoral artery was punctured (Fig. 2-A). The lesion site was confirmed and marked using IVUS (Fig. 2-B), and a self-expandable stent was implanted (Fig. 2-C). The location and expansion of the stent were confirmed by IVUS (Fig. 2-D). Angiography using a very small amount of carbon dioxide gas was performed to confirm the absence of vascular injury (Fig. 2-E). Thereafter, the procedure was completed without the use of a contrast agent.

Case 3 (Fig. 3)

The third case was short chronic total occlusion (CTO) of the distal superficial femoral artery. Using the IVUS catheter as a support catheter, an Asahi Gladius 0.014 guidewire was inserted into the CTO under the guide of

the SCORE Navi + Plus (Fig. 3-A). Successful guidewire passage was achieved by advancing the wire toward the end of the occlusion shown by the SCORE Navi + Plus (Fig. 3-B).

2. Combined use of angiographic apparatus

When contrast agent-free EVT using 3D CT imaging is performed, co-registration of images is the key issue. The integration of angiography and CT imaging is initiated by coordinating biplane fluoroscopy (Fig. 4 : a screen at the time of co-registration [SCORE Navi + Plus]) and 3D imaging on the SCORE 3D workstation. The coordination involves the arm angle, location of the top panel, and magnifying power. Because 3D imaging provides depth information according to the rotation of the arm, it allows not only a decrease in the number of exposures, but also easier manipulation of the wire, in comparison with mapping images obtained by 2D DSA imaging. Accurate synchronization cannot be achieved if the position of the subject varies between CT imaging and EVT. Therefore, in our hospital, CT imaging and EVT are performed using our special device designed to immobilize the lower limbs to ensure that the subject is kept in the same position.

Conclusion

Effective use of 3D images is increasing in the clinical setting. The combined use of fluoroscopic imaging and CT imaging described in this article suggests the generalization of contrast agent dose reduction and contrast agent-free EVT. However, there are several issues that are not limited to the performance of the apparatus alone, e. g., keeping the same body position during CT imaging and EVT, reduction of the procedures and time of registration for angle coordination, and engagement of the entire organization in incorporating these techniques into routine practice. In particular, superimposition of images of a constantly moving area, as in the case of PCI, requires further technical innovation. We believe that, in the future, the fusion of 3D techniques beyond the boundaries of this modality will enable us to provide treatments that impose far less burden on the patient.