3D Cerebral Angiography with Volume Rendering for Small Intracranial Aneurysms: Phantom and Clinical Study

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Purpose
The previous reports of 3D angiography have used MIP and surface rendering. Three-dimensional angiography with volume rendering should have a number of theoretical advantages over MIP and surface rendering. The purpose of this study is to evaluate small intracranial aneurysms less than 5 mm with 3D angiography using volume rendering in comparison with 3D CTA in both clinical cases and phantom.

Materials & Methods
For rotational DSA, 240 projections were acquired during a C-arm movement over a total angle of 220 degree, while 16 to 32 ml of contrast agent were injected. The acquisition conditions are as follows; rotation speed of C-arm: 30 degrees/sec., matrix size: 512 X 512, quantization: 10 bits, and frame rate: 30 frames/sec. Three-dimensional images were reconstructed from the corrected images with Feldkamp method. Aneurysm phantom consisted of five aneurysms with different diameters (2, 3, 5, 7, and 10 mm). The diameters of the parent were 2 mm or 4 mm. In the clinical cases, a total of 10 small aneurysms less than 5 mm were evaluated with 3D CTA, conventional DSA, and 3D angiography.

Results
A 2 mm aneurysm was demonstrated clearly with both phantoms (Fig). Although the images were very good, slight distortion of the aneurysm was observed, and the parent vessel near the large aneurysm seemed to have slight narrowing. When we evaluated 10 small aneurysms, 3D angiography was the best for both detection of aneurysm and evaluation of aneurysm configuration and relationship with adjacent vessels. In all cases with aneurysm, 3D angiography was better than the conventional DSA and rotational DSA concerning visualization of the aneurysm architecture. Three-dimensional angiography also was useful for the evaluation of the aneurysms at the skull base.

Conclusion
High-quality 3D volume-rendering images could be computed from a rotational DSA dataset. In all cases with aneurysm, 3D angiography was superior concerning visualization of the aneurysm architecture. Volume rendered 3D reconstructions of intracranial vessels based on a rotational angiography system overcomes the limitations of CTA and conventional DSA.