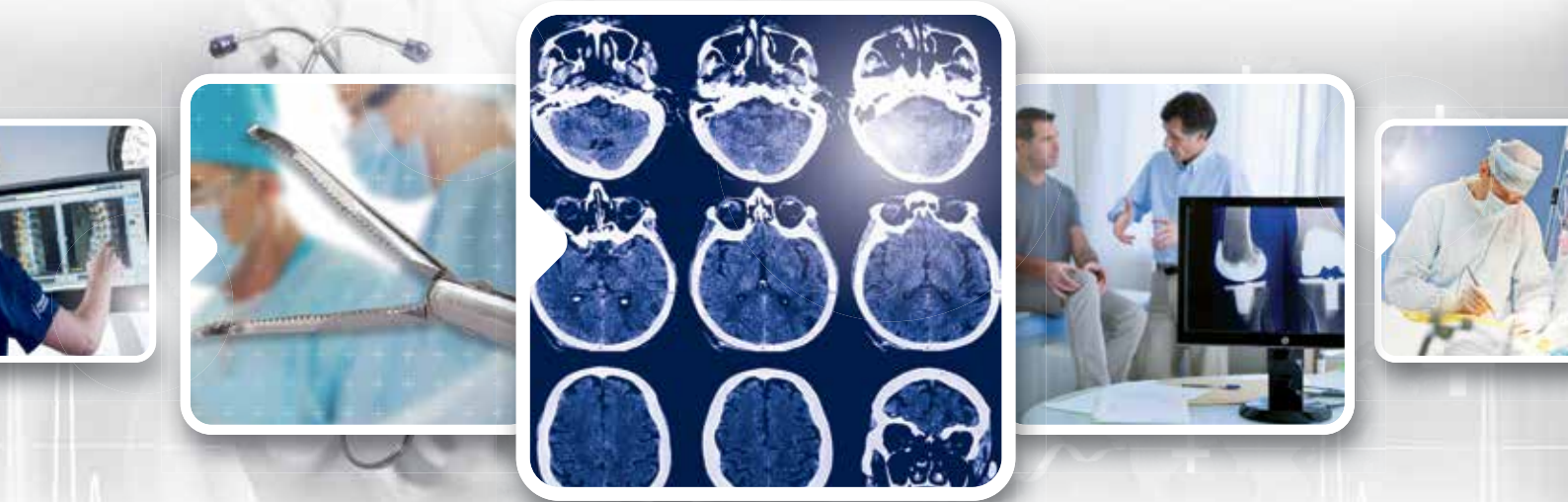


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# Rare use of twin Solitaire<sup>®</sup> stents in the double waffle-cone technique for endovascular treatment of a wide-necked bifurcation aneurysm

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## Abstract

Endovascular treatment of wide-necked bifurcation aneurysms may be challenging. The waffle-cone technique can be used in these aneurysms in case of acute angulation between parent artery and distal artery of the aneurysm. Solitaire<sup>®</sup> stent (Ev3, Irvine, CA, USA) has the significant advantage of mitigating the potential complication risks. This study reports the second case in the literature in which endovascular treatment of a wide-necked bifurcation aneurysm with the double waffle-cone technique by using twin Solitaire<sup>®</sup> stents proved to be successful.

## Keywords

Double waffle-cone technique, Solitaire<sup>®</sup> stent, wide-necked bifurcation aneurysm, acute angle

## Introduction

Endovascular treatment of wide-necked bifurcation aneurysms may be challenging.<sup>1,2</sup> Balloon remodeling, stent-assisted coiling, Y-stenting and multiple-microcatheter techniques were all developed for endovascular treatment of such aneurysms. However, these techniques may not be useful in case of acute angulation between proximal and distal parent arteries due to the difficulty of reaching the distal edge of the aneurysm. In such a case, the waffle-cone technique may be useful for endovascular treatment of the aneurysm.<sup>1</sup>

In this study, we used the double waffle-cone technique in a patient with a wide-necked middle cerebral artery (MCA) bifurcation aneurysm due to the acute angle between proximal and distal parent arteries and difficulty of reaching the distal parent artery. This study presents a rare case in which endovascular treatment of the aneurysm with the double waffle-cone technique by using twin Solitaire<sup>®</sup> stents (Ev3, Irvine, CA, USA) proved to be successful.

## Case report

The selective cerebral digital subtraction angiography (DSA) of a 36-year-old male patient with normal neurological examination and laboratory test results who were examined for complaints of headache showed a 13 mm wide-necked complex aneurysm of the right MCA bifurcation which was 16 × 16 × 19 mm<sup>3</sup> in size, incorporating the upper and lower divisions

(Figure 1). Endovascular intervention was planned for this complex aneurysm of the MCA.

Ticlopidine hydrochloride (250 mg BID) treatment was initiated five days before the endovascular intervention in the patient who was resistant to acetylsalicylic acid and clopidogrel. Following the induction of general anesthesia, a 6F 80 cm Neuron Max (Penumbra, Inc.) guiding catheter was inserted in the right common femoral artery. Systemic heparinization was performed, with the activated clotting time being 200–300 s. The petrous portion of the right ICA was reached with a 6F Fargomax (Balt Extrusion) intracranial access catheter. The DSA that was performed showed a complex aneurysm of the right MCA bifurcation in this patient (Figure 1(a) and (b)).

An attempt was made to reach the upper and lower divisions through the aneurysm of the right MCA bifurcation by using combinations of microcatheters and microguidewires of various models and diameters. However, distal edges of the divisions could not be reached due to the acute angulation. A 4 mm × 20 mm Solitaire<sup>®</sup> stent was inserted in the neck of the aneurysm with the help of the Prowler Select Plus (Codman Neurovascular) in a way to cover the orifice of the

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**Figure 1.** Cerebral and 3D DSA image of the complex wide-necked aneurysm of the right MCA bifurcation, incorporating the upper and lower divisions (a, b). Control DSA image after the endovascular treatment with the double waffle-cone technique showing almost complete closure of the complex aneurysm of the right MCA bifurcation in different projections (c, d).

upper division of M2 segment. An Excelsior SL-10 (Stryker) microcatheter was stabilized inside the aneurysm with the help of a hydrophilic 0.012 inch (Terumo) microguidewire. Then, the second 4 mm × 20 mm Solitaire® stent was inserted in the neck of the aneurysm by using the double waffle-cone technique with the help of the Prowler Select Plus in a way to cover the orifice of the lower division of M2 segment. Later on, embolization of the aneurysm was initiated by using a 14 mm × 30 cm Target 360° (Stryker) coil (Figure 2). Target 360° and 3D Guglielmi Detachable Coils (Stryker) of various sizes were used during embolization of the aneurysm. The post-operative DSA showed almost complete closure of the right MCA bifurcation aneurysm (Figure 1(c) and (d)).

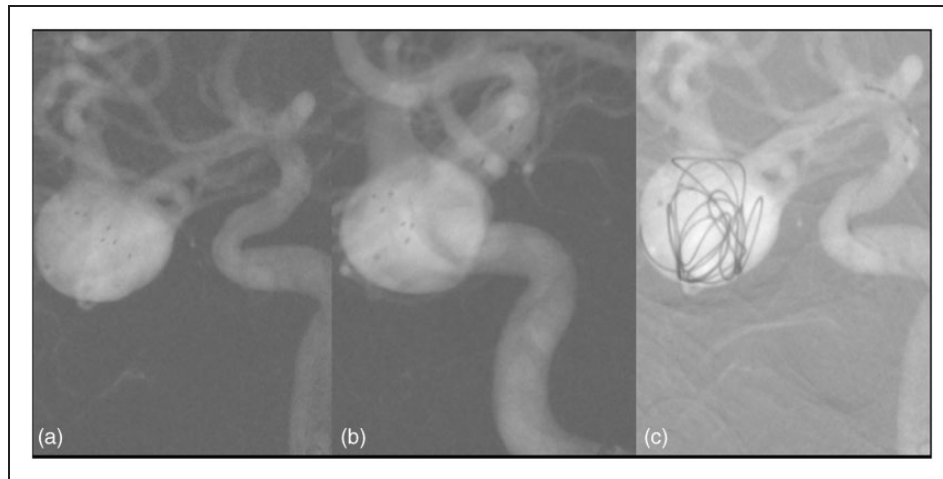
No clinical deficit occurred in the patient following the endovascular treatment. The patient who had a good overall health status was discharged from the hospital on post-operative day 1. He was prescribed 250 mg

ticlopidine hydrochloride BID (for 3-6 months). The control DSA was scheduled for three months later.

## Discussion

Endovascular treatment of complex wide-necked bifurcation aneurysms may be challenging due to their anatomical features.<sup>1,2</sup> Endovascular stenting may be impossible in the neck of the aneurysm because of the acute angle between the distal and parent arteries. In such a case, the waffle-cone technique first described by Horowitz et al. in 2006 can be useful for endovascular treatment of the wide-necked bifurcation aneurysm.<sup>1,3</sup>

The maximum expansion diameter of the current intracranial stents is 5 mm. A larger diameter of the aneurysm neck than the maximum expansion diameter of the stents and the branches arising from across the proximal dome of the aneurysm limit the waffle-cone technique. This limitation has contributed to the



**Figure 2.** Placement of twin 4 mm × 20 mm Solitaire® stents by using the double waffle-cone technique in the neck of the aneurysm in a way to cover the orifices of the upper and lower divisions of M2 segment from different viewpoints (a, b). Initiation of the embolization of the aneurysm with a 14 mm × 30 cm Target 360° coil (c).

development of the double waffle-cone technique, a double stent-in-stent technique. Rahal et al. reported the successful embolization of a wide-necked MCA bifurcation aneurysm by using the double waffle-cone technique with twin Solitaire® stents.<sup>3</sup> This was the only reported case in the literature in which the double waffle-cone technique was successfully used with twin Solitaire® stents for endovascular treatment of the aneurysm, which makes our case even more important as the second case in the literature.

The absence of a platinum wire on its distal end, which might perforate the aneurysm during placement of the stent,<sup>1</sup> a multiple retrieval system and electrolytic detachment design are the important advantages of the Solitaire® stent.<sup>3</sup> Such advantages of the Solitaire® stents might help avoid potential complications.

Furthermore, Mpotsaris et al. used for the first time the waffle-cone technique with double pCONus devices of wide distal diameters in the coil embolization of tandem MCA bifurcation aneurysms.<sup>4</sup> The pCONus device was designed for improving the waffle-cone technique. The device is fully retrievable and electrolytically detachable. The intra-aneurysmal portion of the pCONus device enhances the stabilization.<sup>4</sup>

In addition to the waffle-cone technique, WEB, a recent technique, can also be used for endovascular treatment of the wide-necked bifurcation aneurysms. The device is fully retrievable. It disrupts the blood flow to the aneurysm and occludes it. Use of WEB for endovascular treatment might reduce the thromboembolic events. Lubicz et al. used the WEB for endovascular treatment of the wide-necked bifurcation aneurysms.<sup>5</sup>

In addition to the abovementioned techniques, use of the Pulsar Vascular Aneurysm Neck Reconstruction Device (PVANRD), another recent approach, is also feasible in endovascular treatment of wide-necked bifurcation aneurysms. PVANRD provides

extra-aneurysmal structural support at the aneurysm neck with minimal intravascular surface exposure. Turk et al. reported that PVANRD had unique advantages over the other conventional stents in endovascular treatment of experimental canine bifurcation aneurysms.<sup>6</sup>

Recently developed devices can be used in endovascular treatment of wide-necked bifurcation aneurysms. However, use of these devices in such aneurysms that are difficult to treat requires further data and experience. In addition to these devices, recently developed double waffle-cone technique can also be used for treatment of such difficult aneurysms. In this technique, multiple-purpose Solitaire® stent which allows for multiple retrievals might mitigate the potential complication risks. In the present study, we used Solitaire® stent, which was used for multiple purposes in many cases before, in the double waffle-cone technique for endovascular treatment of a wide-necked bifurcation aneurysm due to lack of experience with the other recently developed devices and difficulty of provision of these devices.

## Conclusion

In the wide-necked bifurcation aneurysms, the double waffle-cone technique might be considered in the event that the wide neck of the aneurysm cannot be passed across due to the acute angle between the proximal and distal parent arteries. The use of Solitaire® stent in this technique might mitigate the potential complication risks. However, there is a need for further data and experience for the widespread use of this technique.

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**Conflict of interest**

None declared.

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