18 Ophthalmic Artery Aneurysm: Subarachnoid Hemorrhage and Visual Disturbance due to a Ruptured Intracranial and Intracanalicular Ophthalmic Artery Aneurysm; Endovascular Remodeling of the Ophthalmic Artery via Flow Re-Direction Endoluminal Device (FRED Jr.); Resolution of the Visual Disturbance; Short-Term Clinical and Radiological Follow-Up

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Abstract

A ruptured saccular intracranial and intracanalicular aneurysm of the ophthalmic artery was found in a 27-year-old male patient with no relevant medical history. He presented to the hospital 2 days after the onset of a thunderclap headache, nausea, some vomiting, subconjunctival hemorrhage, and nonprogressive visual loss in his left eye. After balloon occlusion test run, the patient underwent elective treatment of the true aneurysm of the ophthalmic artery in which a Flow Re-direction Endoluminal Device (FRED Jr.; MicroVention) was inserted. DSA follow-up examinations at 3 and 6 months confirmed complete obliteration of the target aneurysm as well as a completely remodeled left ophthalmic artery. The visual acuity of the left eye improved to finger-count status. The main topic of this chapter is the management of a rare case of a ruptured intracranial and intracanalicular aneurysm of the ophthalmic artery, which was treated with a flow diverter stent.

Keywords

Ophthalmic artery · Intracanalicular ophthalmic segment · Intracranial ophthalmic segment visual disturbance · Balloon test occlusion · Flow diversion · FRED Jr.

Patient

A 27-year-old male who presented to the hospital 2 days after the onset of a thunderclap headache, nausea, some vomiting, subconjunctival

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H. Henkes et al. (eds.), *The Aneurysm Casebook*,
https://doi.org/10.1007/978-3-319-77827-3_139

hemorrhage, and nonprogressive visual loss in his left eye (Fig. 1). The medical history of the patient was otherwise unremarkable.

Diagnostic Imaging

Initial noncontrast computed tomography (NCCT) revealed the presence of a Fisher grade 3 subarachnoid hemorrhage (SAH), predominantly distributed within the basal cisterns around the brainstem. There was no evidence of fractures in either the skull base or the optic canal. Orbital and cranial magnetic resonance (MRI) was performed and revealed an aneurysm arising from the intracranial and intracanalicular ophthalmic segment of the ophthalmic artery (OA). The measurements of the aneurysm were as follows: 2.9 mm in width, 3.3 mm in height, and a neck which was 2.7 mm wide. The distal ophthalmic artery appeared normal. No other cerebrovascular anomalies or aneurysms were seen. The subsequent diagnostic DSA confirmed the diagnosis. The central retinal trunk originated distal to the aneurysm (Fig. 2).

Treatment Strategy

The anatomical characteristics of the aneurysm and the probability that the left optic nerve was being compressed implied that the OA aneurysm would have been amenable to surgical treatment by decompressing the optic canal through proximal clip ligation of the aneurysm. However, the patient and his relatives declined this proposed approach due to cultural beliefs and the cost of the surgical procedure. Following multidisciplinary team discussion, it was decided to attempt the parent artery repair with a flow-diverter stent. This would have to be done under the challenging setting of a dreadful intracranial hemorrhage with no patent collaterals, rather retrograde perfusion of the left ophthalmic artery through the left external carotid artery. The patient and his relatives were informed of the details as per hospital policy and appropriate consent was obtained. Dual antiplatelet therapy (DAPT) with 75 mg clopidogrel PO daily and 100 mg ASA PO daily was assigned to the patient for 6 days with the goal of achieving adequate platelet inhibition prior to the procedure. A response test to DAPT was then carried out which confirmed that platelet function had been suitably inhibited.

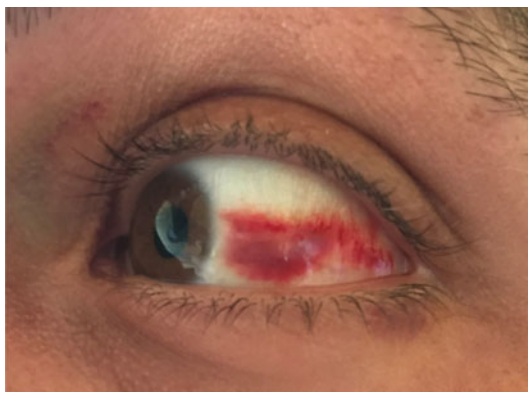


Fig. 1 The appearance of the subconjunctival hemorrhage at the time of admission. By this point, the hemorrhage has also suffused into the lids and the orbital soft tissues

Treatment

Procedure, 07.11.2018: endovascular treatment of a ruptured aneurysm of the left OA by flow diversion

Anesthesia: general anesthesia, 1× 5000 IU non-fractionated heparin (Heparinum WZF, WPW Polfa) IV

Premedication: 1× 100 mg ASA (Aspirin, Bayer Vital) PO daily and 1× 75 mg clopidogrel (Actavis) PO daily, initiated 6 days prior the procedure

Access: right common femoral artery, 6F sheath (Terumo); left common femoral artery, 4F sheath (Terumo); *guide catheter:* 6F Envoy DA (Johnson & Johnson); *microcatheter:* Headway 21 (MicroVention); *microguidewire:* pORTAL 14 (phenox)

Implant: FRED Jr. 2.5–8/13 (MicroVention)

Course of treatment: A 6F Envoy guide catheter was navigated into the left internal carotid artery (ICA). DSA, including standard and oblique projections, was performed to gain a better understanding of the aneurysm geometry clear of the surrounding structures. The following 3D reconstructions of the aneurysm and the OA

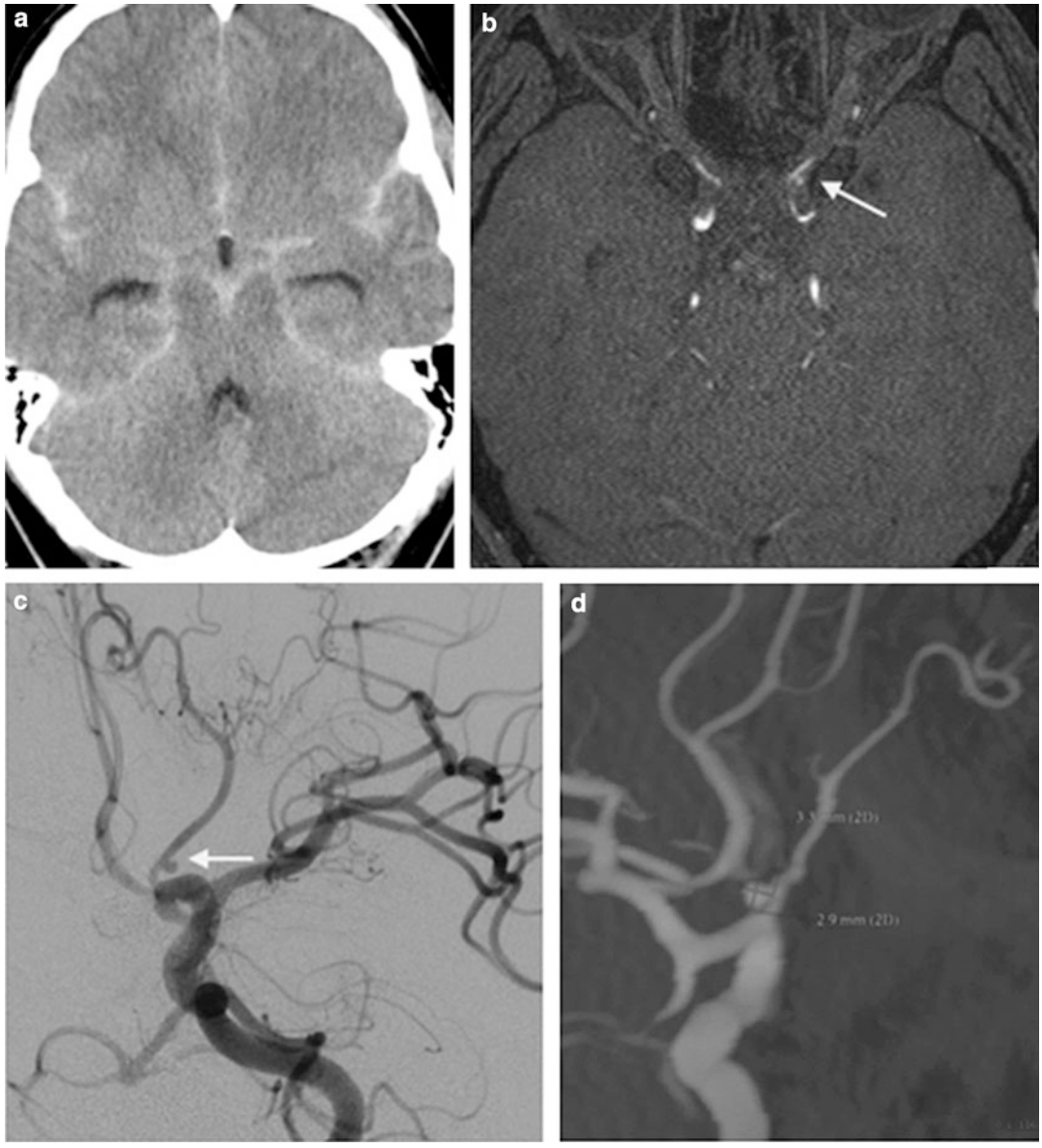


Fig. 2 (continued)

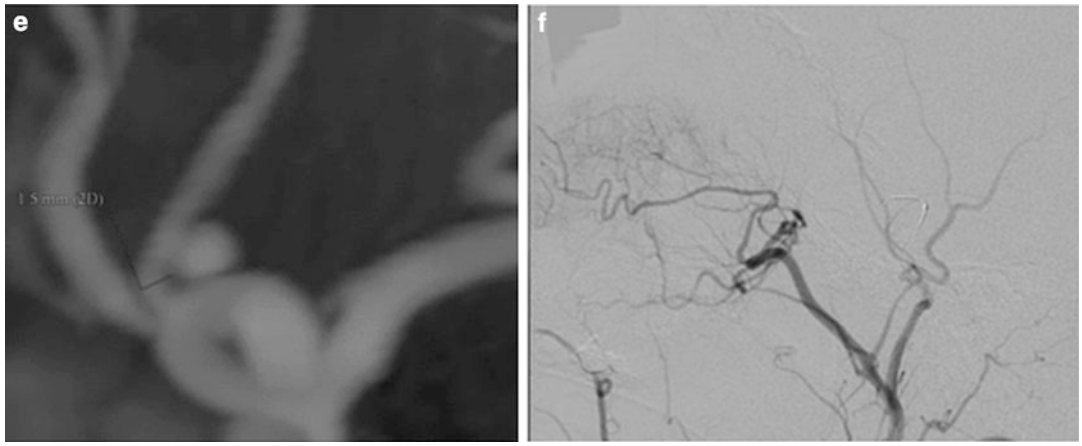


Fig. 2 Diagnostic imaging of a small ruptured true ophthalmic artery aneurysm. Diagnostic noncontrast CT (NCCT) (**a**) showing a diffuse and peripheral subarachnoid hemorrhage, extending into the basal cisterns. Time-of-flight (TOF) MR image (**b**) showing a saccular aneurysm located on the intracranial and intracanalicular portion of the left OA. Digital subtraction angiography (DSA) oblique (**c**) projection of the target aneurysm (arrow). Rotational DSA with 3D reconstructions (**d**, **e**) showing the anatomical details of the ruptured aneurysm and the proximal diameter of the OA. DSA contrast injections during the balloon tolerance test with the balloon inflated in the left internal carotid artery (**f**). Note the absence of retrograde blood flow and patent collaterals from the ECA to the left OA

revealed notable growth of the aneurysm and its size, especially across the neck. Under road map guidance, a Headway 21 microcatheter was navigated over a microguidewire and positioned distally into the OA. The decision to perform parent artery reconstruction using a FRED Jr. 2.5–8/13 stent was taken due to the absence of collateral blood flow, the relatively wide neck of the aneurysm, and the need to preserve the OA. Once the microcatheter was in place, this was used to deploy the stent. The FRED Jr. was well sited, with adequate proximal and distal landing zones and completely covering the aneurysm. Excellent apposition to the artery wall was seen during the control contrast injections with no visible gap between the stent and the OA wall. The patency of both the flow diverter and the OA vasculature was confirmed (Fig. 3).

Duration: 1st–11th run: 45 min; fluoroscopy time: 16 min

Complications: none

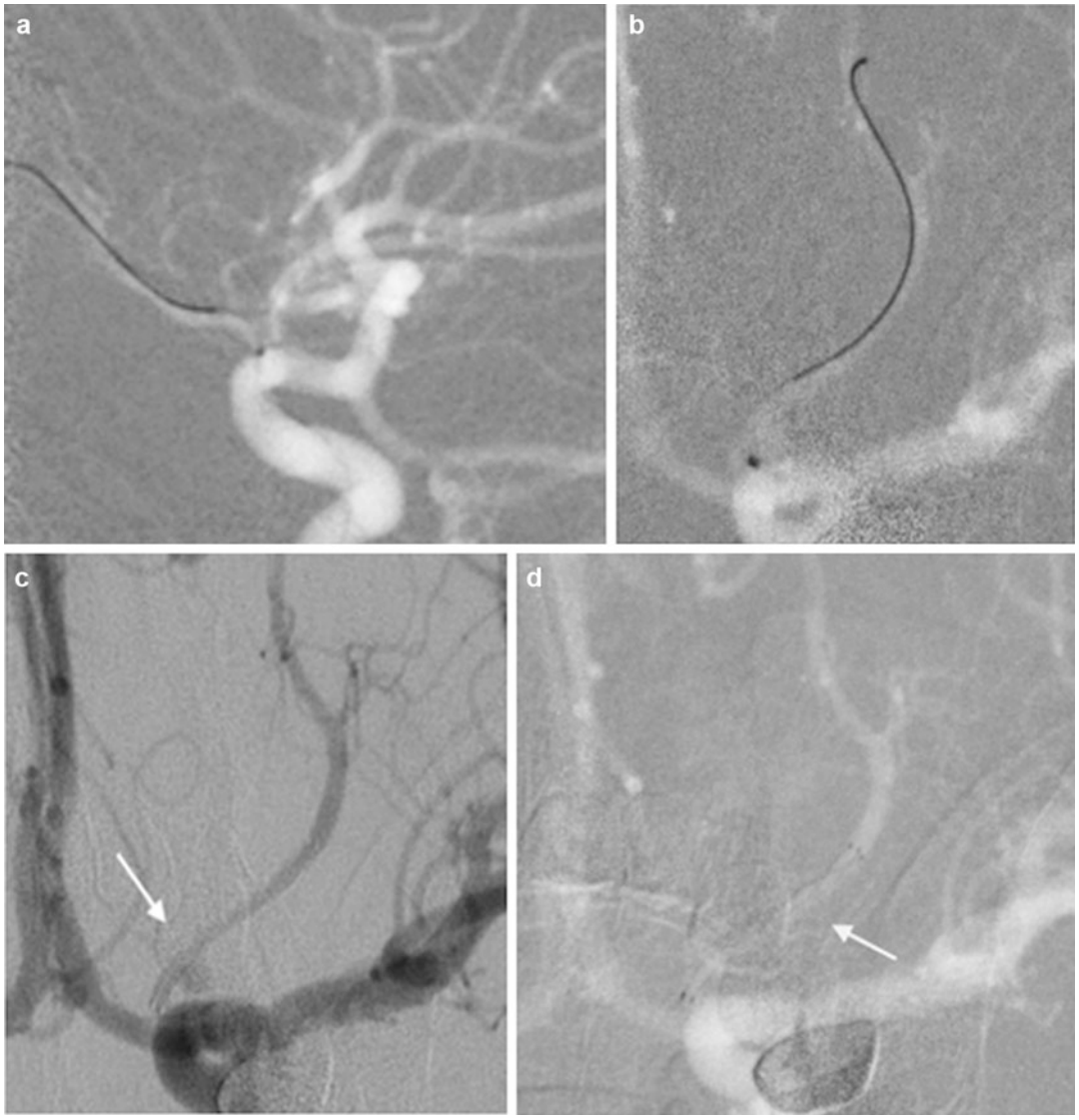
Postmedication: 1× 100 mg ASA PO daily for 12 months and 1× 75 mg clopidogrel PO daily for 6 months

Follow-Up Examinations

Three and 6-month follow-up DSA examinations were carried out after the endoluminal reconstruction of the left OA. The angiograms confirmed that the target aneurysm had been completely obliterated and the left OA fully remodeled. No in-stent or parent artery stenotic changes were observed (Fig. 4).

Clinical Outcome

The endovascular procedure was well tolerated with no change to the patient's neurological or clinical baseline condition. The patient was discharged home 7 days later with no new neurological deficit. Visual acuity of the left eye improved to finger-count status. An ophthalmological examination had ruled out both Terson's syndrome and glaucoma.



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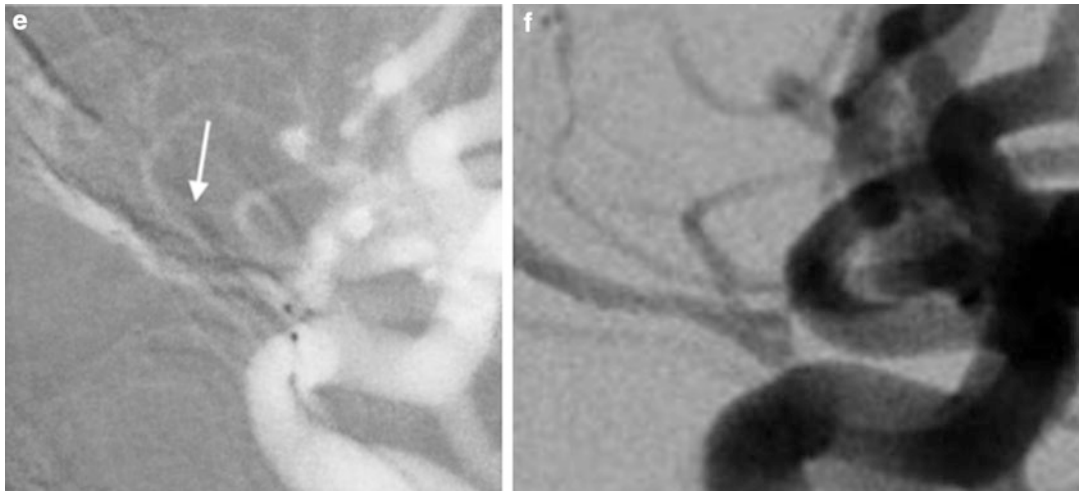

Fig. 3 Endovascular treatment of an intracranial and intracanalicular aneurysm of the OA using a FRED Jr. flow diverter. Using a suitable working projection, selective catheterization of the left OA was achieved (**a**, **b**) with a microguidewire and Headway 21 microcatheter, followed by deployment of the stent (**c**, **d**) (arrow). The excellent distal and proximal placement of the stent was confirmed by a control DSA (**e**, **f**) as was the full patency of the parent vessel

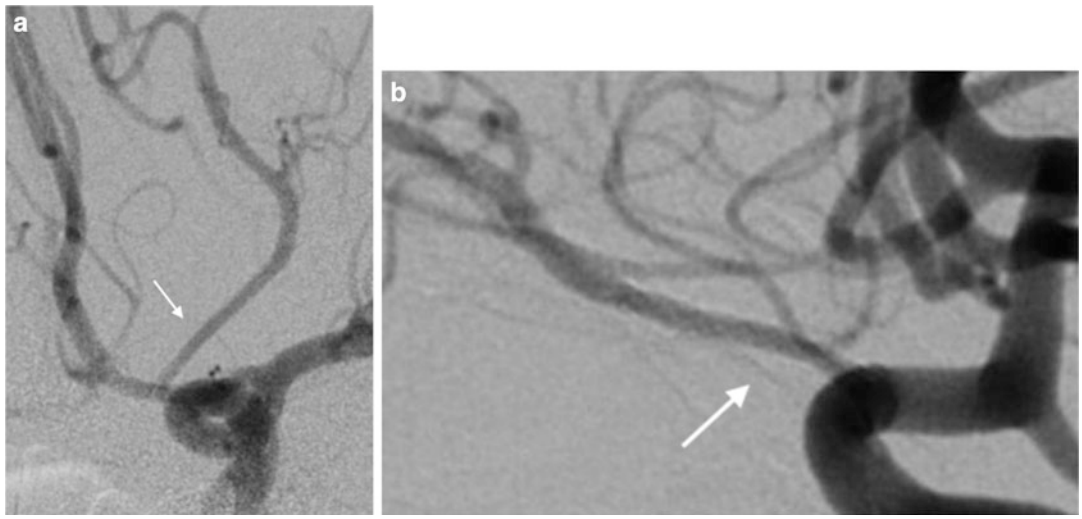

Fig. 4 A 6-month follow-up DSA (**a**, **b**) showing the complete vessel reconstruction of the left OA with no recanalization or residual contrast. No in-stent or arterial stenosis was seen (arrow)

Discussion

Aneurysms located at or around the origin of the OA are predominantly called "ophthalmic" aneurysms as this term refers to the abbreviation of a "carotid-ophthalmic aneurysm" (Drake et al. 1968; Jain 1970). On the other hand, "true" or peripheral aneurysms of the ophthalmic artery are an extraordinary entity and can be anatomically located across any part of the artery: the intracranial, the intracanalicular, the intraorbital, or the terminal ophthalmic branches (Ogawa et al. 1992).

These aneurysms are heterogeneous by nature, and their clinical features and natural course are

not completely understood. As a result, the best treatment options and clinical management are still being debated. There is a very limited body of literature available, covering studies and case reports on the incidence, etiology, manifestation, and clinical course of these lesions. In their comprehensive literature review, Qiao et al. (2011) identified a total number of 35 reported cases where the majority of the lesions involved the intracranial or intraorbital segment of the OA, while only two cases reported on aneurysms in the intracanalicular segment. Shared neurological symptoms and clinical features include a progressive reduction in visual acuity, visual field defects, and proptosis, mainly due to mass effect exerted by the aneurysm (Raitta 1968; Rengachary and Kishore 1978). The clinical presentation may vary according to which artery segment is involved. However, the rupture rate is known to be relatively low (Dehdashti et al. 2002).

As mentioned in previous reports, visual deterioration is often seen with the involvement of the intracanalicular segment and responds poorly to treatment (Choi et al. 2008; Piché et al. 2005).

In our case, the presence of an SAH, the vision deterioration, and the width of the aneurysmal neck all prompted a less invasive approach. The absence of adequate collaterals from the ECA and a retrograde perfusion of the OA suggested that a proximal endovascular occlusion of the OA would have been potentially hazardous and might have compromised the blood supply of both the orbit and the eye.

In the past decade, flow diversion as a treatment for small or uncoilable intracranial aneurysms has become a well-accepted, sturdy, and relatively safe procedure. Theoretically speaking, placing a stent across the neck of the aneurysm should redirect the blood flow and decrease intra-aneurysmal pressure by stopping the blood circulation inside the aneurysm (Cantón et al. 2005). This would reduce the risk of a fatal aneurysmal re-rupture, prevent further growth, reduce mass effect, and, thus, minimize optic nerve compression. Despite the presence of an intracranial hemorrhage, endovascular remodeling of the parent artery caused by the hemodynamic effect of a flow diverter stent was considered to be an appropriate approach.

Deploying a flow diverter in such a small caliber artery must be performed with a high level of accuracy. Both the vessel anatomy and the physical parameters of the implant (e.g., radial force, foreshortening) have to be considered. During deployment, the final position of the device has to be anticipated by the operator. The proximal end of the flow diverter should be positioned just at the opening to the OA. A risk is that the proximal end of the flow diverter could inadvertently be positioned inside the lumen of the ophthalmic segment of the ICA. This would most likely increase the risk of thromboembolic complications. If the flow diverter does not cover the proximal margin of the aneurysm, the intended hemodynamic effect may not be achieved. The recently introduced and miniaturized low-profile flow diverter Silk Vista Baby (Balt Extrusion) can be deployed via a 0.017″ ID microcatheter. This implant could have simplified the treatment of the aneurysm in our patient. Furthermore, given the diameter of the OA and the location of the aneurysm in our case, it is obvious that the use of a smaller microcatheter would have been easier and safer. Combing through the literature, we were unable to find a similar report. To the best of our knowledge, this is the first case report describing a low-profile flow diverter being inserted for the treatment of an acutely ruptured intracranial and intracanalicular aneurysm of the OA. This procedure eventually resulted in the obliteration of the aneurysm, while maintaining the patency of the parent artery. We assume that this approach could be applied to similar intracranial and intracanalicular OA aneurysms, particularly in patients for whom it is crucial that the parent vessel is preserved.

Therapeutic Alternatives

Balloon-Test Occlusion
Microsurgical Management
p48 Flow Modulation Device
Parent Vessel Occlusion
Pipeline Embolization Device, PED
Silk Vista Baby

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