

## Use of Flow Diversion for the Treatment of Distal Circulation Aneurysms: A Multi-Cohort Study

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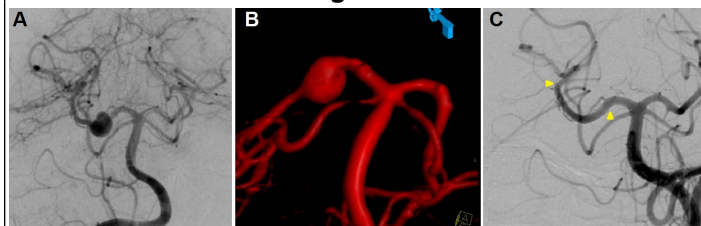
### Introduction

The safety and efficacy of flow diversion for distal circulation aneurysms of the cerebral vasculature has not been well-evaluated. The objective of this study was to assess the use of flow diversion for aneurysms located beyond the circle of Willis in an international, multi-center cohort. 'Distal' was defined at, or beyond, the M1, P2 and A2 segments of the MCA, PCA and ACA, respectively.

### Methods

Clinical and radiological records from all patients undergoing flow diversion treatment of distal circulation aneurysms at 3 academic centers (2 US, 1 Europe) from 2014 until 2017 were retrospectively reviewed.

**Figure 1**



Illustrative case. A 46-year-old female was found to have a 10 mm PCA aneurysm following evaluation of headache. Diagnostic cerebral angiogram demonstrates a fusiform aneurysm along the right P2 segment (A, anteroposterior projection, B 3-dimensional reconstruction). Two PED stents, measuring 2.5 x 18 mm and 2.5 x 10 mm respectively, were placed across the aneurysm neck in the P2 and P3 segments. On subsequent 6-month follow-up, good wall apposition of both stents was seen (C anteroposterior projection, yellow arrows) with no evidence of residual aneurysm filling, or in stent stenosis.

Parameter	Result
<b>Number of patients</b>	<b>n=46</b>
<b>Gender</b>	
Female	33 (71.7%)
<b>Age (Years)</b>	58.2 (±14.6)
<b>Smoking history</b>	10 (21.7%)
<b>Previous SAH &gt;2 weeks</b>	9 (19.6%)
<b>Multiple intracranial aneurysms</b>	7 (15.2%)
<b>Pretreatment mRS</b>	
0	38 (82.6%)
1	6 (13.0%)
2	2 (4.3%)

### Results

41 patients (mean age=57.6 years, 29 women) harbouring 41 aneurysms who underwent treatment with either the Pipeline Embolization Device (Medtronic Inc, Dublin, Ireland) or the Flow Redirection Endoluminal Device (Microvention, Tustin, California) were included in these analyses. 32 aneurysms (78%) were located in the anterior circulation and 9 (22) were located in the posterior circulation. With a median follow-up of 7.9 months, complete (100%) and near-complete (90-99%) occlusion was noted in 32 (78%) of aneurysms. Angiographic evidence of side branch or perforator vessel coverage was present in 31 (75.6%) of aneurysms and was associated with failure to occlude at follow-up (P=0.04). All patients had good functional outcomes post-treatment (mRS 0 to 2). There were two cases (4.9%) of perforator vessel stroke and no hemorrhagic complications.

### Conclusions

Flow diversion is a safe and effective treatment modality for aneurysms beyond the circle of Willis with occlusion rates comparable to alternative treatments and low morbidity. The clinical significance of flow limitation through covered side branches requires further

### References

1. Becske T, Kallmes DF, Saatci I, McDougall CG, Szikora I, Lanzino G et al. Pipeline for uncoilable or failed aneurysms: results from a multicenter clinical trial. *Radiology*. 2013; 267:858-68.

**Table 2**

Parameter	Result
<b>Procedure details</b>	<b>n=46</b>
<b>Type of treatment</b>	
Flow-Diverter deployment	36 (78.3%)
Flow-Diverter deployment + adjunctive coiling	10 (21.7%)
<b>Type of Flow-Diverter placed</b>	
Pipeline	43 (93.5%)
FRED JR	3 (6.5%)
<b>Number of Flow-Diverter placed</b>	
1	34 (73.9%)
2	8 (17.4%)
3	4 (8.7%)
<b>Nominal diameter size of FD deployed (mm)</b>	2.5 (Range 2.5 to 3.75)
<b>Parent vessel diameter (mean ± standard deviation)</b>	
proximal	
distal	
<b>Perforator vessel coverage with flow diverter ('jailing')</b>	35 (76.1%)
<b>Platelet Function assay before procedure</b>	20 (43%)
LTA	17 (85%)
VerifyNow	3 (15%)
<b>Clopidogrel responder</b>	20 (43%)
No	8 (40%)
Yes	12 (60%)
<b>Post-treatment mRS*</b>	
0	39 (84.8%)
1	4 (8.7%)
2	1 (2.2%)
<b>Post-Procedure antiplatelet drug</b>	
ASA 325mg + clopidogrel 75mg	38 (82.6%)
ASA 81mg + ticagrelor 180mg	6 (13.0%)
ASA 325 mg + prasugrel 10 mg	2 (4.3%)
<b>Thromboembolic complications</b>	8 (17.4%)
Timing	
Intraoperative**	5 (10.9%)
Post-operative***	3 (6.5%)
Permanent	2 (4.3%)
Transient	6 (13.0%)
<b>Intracranial hemorrhagic complications</b>	0 (0%)
<b>Other procedural related complications</b>	1 (2.2%)
Fracture of distal part of FD deployment	1 (2.2%)
<b>Need for retreatment</b>	2 (6.5%)
Flow-diverter placement	2 (100%)
<b>Last radiographic follow-up, months (mean± standard deviation)</b>	13.0 ± 9.9
<b>Last follow-up occlusion rate</b>	
Occluded (100%)	31 (67.4%)
Near completely occluded (90-100%)	5 (10.8%)
Incompletely occluded (<90%)	10 (21.7%)
<b>In stent stenosis on follow-up (all asymptomatic)</b>	7 (15.2%)

\*2 missing data

\*\*Transient parent artery occlusion (all resolved with intra-arterial thrombolysis)

\*\*\*Branch occlusion

\*\*Perforator infarct (resolution of symptoms)

### Treatment details