

# Surface-modified flow diverters for intracranial aneurysms: a meta-analysis

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## Background

- Newer flow diverters have anti-thrombogenic surface modifications marketed to reduce ischaemic events (Table 1).
- We summarize the clinical and radiological outcome of patients with cerebral aneurysms treated by these devices.

## Materials and Methods

- PRISMA-compliant systematic review and meta-analysis covering 3 major databases between 2014-2019.
- Risk of bias assessment by 2 independent authors with the NIH Quality Assessment Tool.
- Random effects model and Freeman-Tukey arcsine transformation to pool efficacy and safety outcomes.
- Subgroup analysis to compare outcomes between 2 different flow diverters.

## Results

- 8 single-arm case series studying SPED and DED in 911 patients and 1060 aneurysms. Median follow up of 8.24 months (IQR: 6.7-12.0 months).
- Most studies were of good quality.
- No significant statistical heterogeneity nor difference between the 2 flow diverters on subgroup analysis.
- Limitations include retrospective, observational design in some studies, heterogenous and underreported antiplatelet therapy, and potential performance and ecological bias

## Conclusions

The early therapeutic efficacy and safety profiles for surface-modified flow diverters are encouraging, but the lack of long term follow up data and clinical heterogeneity amongst studies preclude strong recommendations for their use over older devices at this juncture.




Device Name	Pipeline Shield (SPED)	Derivo (DED)	P64 / P48MW HPC
<b>Manufacturer/ Release</b>	Medtronic / 2014	Acandis / 2016	Phenox / 2017
<b>Stent structure</b>	Permanent mesh cylinder braided from platinum, tungsten and cobalt-chromium-nickel alloy wires	24 nitinol wires with radio-opaque platinum core looped at the end, with a 48 wire braid	Drawn filled tubing (DFT) wires with platinum core and nitinol coating
<b>Diameter/Length</b>	2.5-5mm / 10-35mm	3.5-6mm/ 15-50mm	P64: 2.5-5mm/ 9-30mm P48MW: 1.75-2mm/ 9-18mm
<b>Surface modifier</b>	Phosphorylcholine (PC) polymer covalently bonded to stent braids (SHIELD technology)	BlueXide: 50nm Titanium oxide and Titanium Oxynitride surface finishing	phenox Hydrophilic Polymer Coating (pHPC) covalently bonded to stent braids
<b>Proposed mechanism</b>	PC is a constituent of the red cell membranes thus reduces platelet adhesion and activation	Reduces friction during delivery and expansion thus reducing thrombogenicity	Mimics glycocalyx on the vessel wall to inhibit platelet plug formation
<b>Appearance</b>			

Table 1. Overview of surface-modified flow diverters

	Overall	DED	SPED	Inter-group heterogeneity
<b>Efficacy Outcomes</b>				
<b>Technical Success</b>	<b>99.6%</b> (98.6-99.8%) $I^2=33.0\%$ $p=0.165$	<b>100%</b> (99.2-100%) $I^2=0.00\%$ $p=0.487$	<b>99.2%</b> (97.2-100%) $I^2=54.4\%$ $p=0.087$	$p=0.165$
<b>Aneurysm Occlusion Rate (6 months)</b>	<b>80.5%</b> (74.5-86.0%) $I^2=70.8\%$ $p=0.000$	<b>78.9%</b> (74.3-83.1%) $I^2=0.00\%$ $p=0.559$	<b>82.7%</b> (73-90.4%) $I^2=75.3\%$ $p=0.000$	$p=0.420$
<b>Aneurysm Occlusion Rate (12 months)</b>	<b>85.6%</b> (80.6-90.0%) $I^2=0.00\%$ $p=0.744$	<b>87.8%</b> (80.9-93.5%) NA	<b>83.2%</b> (75.8-89.6%) NA	$p=0.329$
<b>Safety Outcomes</b>				
<b>Mortality Rate</b>	<b>1.0%</b> (0.3-1.9%) $I^2=0.00\%$ $p=0.608$	<b>1.3%</b> (0.2-3.1%) $I^2=5.47\%$ $p=0.366$	<b>0.8%</b> (0.1-1.9%) $I^2=0.00\%$ $p=0.675$	$p=0.410$
<b>Morbidity Rate</b>	<b>6.0%</b> (4.5-7.7%) $I^2=0.00\%$ $p=0.857$	<b>6.3%</b> (3.9-9.1%) $I^2=0.00\%$ $p=0.618$	<b>5.8%</b> (3.9-8.1%) $I^2=0.00\%$ $p=0.710$	$p=0.725$
<b>Total Ischaemia Rate</b>	<b>6.7%</b> (4.1-10.1%) $I^2=61.9\%$ $p=0.010$	<b>8.3%</b> (2.9-15.7%) $I^2=75.1\%$ $p=0.007$	<b>6.3%</b> (3.2-10.2%) $I^2=50.1\%$ $p=0.111$	$p=0.548$
<b>Serious Ischaemia Rate</b>	<b>1.8%</b> (0.8-3.0%) $I^2=12.1\%$ $p=0.335$	<b>2.5%</b> (1.0-4.6%) $I^2=0.00\%$ $p=0.685$	<b>1.2%</b> (0.1-3.2%) $I^2=37.0\%$ $p=0.190$	$p=0.240$

Table 2. Results of meta-analysis. Table showing pooled point estimate, 95% confidence intervals, heterogeneity ( $I^2$  statistic and p value for Cochrane's Q test) and inter-group heterogeneity.

**Reference:** Li YL, Roalfe AL, Chu EYL et al. Outcome of flow diverters with surface modifications in treatment of cerebral aneurysms - Systematic review and meta-analysis. *AJNR Am J Neuroradiol.*, 2020 (in press)