

On-line Table 1: Main features of endoluminal flow-diverting devices

| Device | Diameter (mm) | Length (mm) | Coverage (%) | Porosity (%) | Pore Size (μm) | Deployment | Resheathable | Comments |
|--------------------|----------------------------------|--|--|---|---|---|---|---|
| PED | 2.5–5.0 ^a | 10–35 | Variable ^b | Variable ^b | Not reported | Pusher wire with unsheathing and redeployed up to 2 times | No | – |
| Pipeline Flex | 2.5–5.0 ^a | 10–35 | 30–35 | 65–70 | Not reported | Can be repositioned and redeployed up to 2 times | Yes, fully | Device identical to parent product but with enhanced delivery system |
| Silk | 2.0–5.0 | 15–40 | 40–55 | 45–60 | 110–250 | Not reported | Not reported | – |
| Silk + FRED | Not reported 3.5–5.5 | 15–40 ^c 10–38 ^d | Not reported 22–44 | Not reported Inner layer low, outer layer high | Not reported Not reported | Not reported Push-pull | Yes, up to 90% Yes, up to 80% | Available in tapered sizes; enhanced visibility vs Silk Full-length radiopacity; can be simultaneously deployed or partially retrieved by single operator |
| p64 | 2.5–5.0 | 12–36 | Not reported | Not reported | Not reported | Mechanical detachment (complete) | Yes | Complete deployment with full recoverability |
| Surpass Streamline | 2.0–5.0 | 12–50 | 70 | 30 | Not reported | Distal catheter with pusher catheter | Yes (≤ 11 mm between catheter tip and pusher must remain) | 67%, 61%, and 34% less tracking force than Pipeline, or FRED, respectively; can be repositioned distally or proximally |
| Tubridge | 2.5–6.5 | 12–45 | 30–35 ^e | 65–70 | 0.04–0.05 mm ² ^f | Push-pull | Yes, to marker at midpoint of device | More braided microfilaments for large sizes; decreases shortening rate after full opening |
| eCLIPs | Single size for vessels 2.0–3.25 | 7.5 (aneurysm); 10 (overall) | 23% (3.25-mm vessel), 42% (2.00-mm vessel) | 77% (3.25-mm vessel), 58% (2.00-mm vessel) | Not reported | Self-orienting | Yes, fully retrievable | Hybrid stent-like assist device with flow-diverter properties that allow trans-device coil placement if required |
| Derivo | 3.5–6.0 | 15–50 | 35–38 | 62–65 | 0.042–0.053 mm ² (4.0/4.5-mm diameter devices) | Mechanical detachment | Yes | Radiopaque Pt core aids visibility; special surface treatment makes wires extremely smooth and corrosion-resistant |
| Sphere | 4.5–6.5 | NA (Sphere) | 46 (6.5-mm device) | 54 (6.5-mm device) | 0.196–0.3508 mm ² (6.5-mm device) | Mechanical detachment | Yes | Dedicated (primarily) bifurcation device |

Note:—NA indicates not applicable.

^a In 0.25-mm increments according to length ranges.

^b Depends on device sizing relative to artery and configuration of deployed device.

^c For nontapered option.

^d Working length.

^e At aneurysmal neck.

^f Gradient with lowest size in middle of device.

On-line Table 2: Outcomes from key trials of endoluminal flow-diverting devices

| Device, Study | Description | Patients (No.) | Aneurysms (No.) | Indication | Occlusion Rate (%) | Morbidity ^a (%) | Mortality (%) | Reference |
|-------------------|--|------------------|------------------|---|--|----------------------------|---|--|
| PED | | | | | | | | |
| PITA | Prospective, multicenter, single-arm European trial | 31 ^b | 31 | Unruptured, wide-neck (dome/neck ratio <1.5) or failed previous therapy, predominantly ICA | 93.3 (at 180 days) | 6.5% | 0 (at 180 days) | Nelson et al, 2011 ¹⁶ |
| PUFS | Prospective, multicenter, single-arm US trial | 108 ^c | 108 | Unruptured, large/giant wide-neck ICA aneurysms | 73.6 (78/106 ^d at 180 days) | 2.8 ^e | 2.8 | Beckske et al, 2013 ¹⁸ |
| PUFS (1 yr) | | 89 | 91 | | 86.8 | 0 ^f | 0 ^f | Beckske et al, 2013 ¹⁸ |
| PUFS (3 yr) | | 74 | 76 | | 93.4 | 0 ^f | 0 ^f | Beckske et al, 2017(b) ¹⁷ |
| PUFS (5 yr) | | 61 | 63 | | 95.2 | 0 ^f | 0 ^f | Beckske et al, 2017(a) ¹⁷ |
| ASPIRe | Prospective, multicenter, observational registry study | 191 | 207 | Unruptured, predominantly large/giant ICA aneurysms | 74.8 ^g (Median follow-up, 7.8 mo) | 5.2 | 1.6 | Kallmes et al, 2015 ²¹ |
| IntrePED | Retrospective, multicenter, international registry study evaluating neurologic complications | 793 | 906 ^h | Predominantly unruptured ICA (≥ 10 mm, n = 311; <10 mm, n = 349); anterior other, ≥ 10 mm (n = 178) and posterior (n = 59) aneurysms | – | 7.1 | 3.8 (1.4% in anterior ICA, <10 mm, 10.9% in posterior aneurysm group) | Kallmes et al, 2015 ²¹ |
| Grissenauer et al | Retrospective, multicenter case review, North America and Europe | 129 | 131 | Posterior circulation aneurysms | 78.1 (Median follow-up, 11 mo) | 7.8 | 9.4 | Grissenauer et al, 2018 ⁷³ |
| Silk | | | | | | | | |
| – | Prospective, multicenter, cohort study | 29 | 34 | Unruptured, fusiform or wide-neck intracranial aneurysms in various anatomic locations | 69.0 ⁱ | 15.0 | 4.0 | Lubicz et al, 2010 ⁴⁴ |
| – | Prospective, multicenter, global cohort study | 70 | 70 | Unruptured (n = 60) and recently ruptured (n = 10), saccular or fusiform intracranial aneurysms in various anatomic locations | 49.0 ⁱ (Median follow-up, 119 days) | 4.0 | 8.0 | Byrne et al, 2010 ⁴⁵ |
| – | Retrospective, single-center, case review | 157 | 180 | Predominantly unruptured, saccular aneurysms of ICA | 78.1 | 9.6 (6 mo) | 3.2 (6 mo) | Pumar et al, 2017(a) ⁴⁶ |
| – | Retrospective, multicenter, Canadian registry study | 92 | 103 | Predominantly saccular aneurysms of ICA | 83.1 ^k (Median follow-up, 12 mo) | 8.7 | 4.3 | Shankar et al, 2016 ⁴⁷ |
| – | Retrospective, multicenter, French registry chart review | 65 | 77 | Unruptured or recanalized saccular or fusiform aneurysms, predominantly of ICA | 68.0 ⁱ (6 mo), 84.3 ^l (1 yr) | 7.8 (6 mo) | 3.4 (6 mo) | Berge et al, 2012 ⁴⁸ |
| – | Retrospective, single-center, case review | 76 | 87 | Predominantly saccular, wide-neck (>4 mm) aneurysms of ICA | 87.8 ⁿ (Mean follow-up, 17.5 mo) | 3.9 | 6.6 | Velioglu et al, 2012 ⁴⁹ |
| – | Retrospective, multicenter, case review | 104 | 109 | Small (<10 mm; mean, 4.7 mm), unruptured aneurysms, predominantly of ICA | 88.5 ^o | 2.9 | 0.9 | Pumar et al, 2017(b) ⁴⁶ |
| FRED | | | | | | | | |
| – | Prospective, single-center, cohort study | 29 | 34 | Wide-neck (fundus/neck ratio, <2 or neck diameter, >4-mm) fusiform, or giant (≥ 25 -mm maximum diameter) aneurysms predominantly of ICA | 73.0 ^p (6 mo) | 3.4 | 0 | Möhlenbruch et al, 2015 ⁵⁹ |
| – | Retrospective, multicenter, case review | 50 | 52 | Unruptured (n = 44), mainly anterior (75%) intracranial aneurysms | 75.0 ^q (12 mo) | 4.0 | 2 | Dmytriw et al, 2017 ²⁸ |
| EUFRED | Retrospective, multicenter, registry study | 531 | 579 | Predominantly anterior saccular aneurysms | 91.3% (1 yr) | 0.8 | 1.5 | Killer-Oberpfalzer et al, 2018 ³⁷ |
| – | Retrospective, single-center, case review | 50 | 52 | Wide-neck, blisterlike, or fusiform/dissecting aneurysms of any size, predominantly at ICA bifurcation (88%) | 87.2 ^r (6 mo) | 0 | 0 | Luecking et al, 2017 ⁵⁵ |
| – | Retrospective, single-center, case review | 33 | 37 | Predominantly unruptured, wide- or no-neck saccular aneurysms of ICA | 100.0 (7–12 mo) | 0 | 0 | Kocer et al, 2014 ⁶⁰ |
| – | Retrospective, single-center, case review | 20 | 24 | Unruptured, saccular, predominantly ICA | 83.0 | 0 | 0 | Briganti et al, 2017 ¹¹ |
| p64 | | | | | | | | |
| – | Retrospective, single-center, case review | 121 | 130 | Unruptured (or-beyond acute SAH phase), recurrences after coiling (n = 20) or clipping (n = 3), mostly anterior/ICA (n = 13 posterior); median neck diameter, 3-mm; median fundus, 4 mm | 85.7 ^s (Median follow-up, 496 days) | 1.7 | 0.8 | Fischer et al, 2015 ⁶⁹ |

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On-line Table 2: Continued

| Device, Study | Description | Patients (No.) | Aneurysms (No.) | Indication | Occlusion Rate (%) | Morbidity ^a (%) | Mortality (%) | Reference |
|--------------------|---|-----------------|-----------------|--|---|----------------------------|----------------------------------|------------------------------------|
| — | Retrospective, multicenter, case review | 40 | 50 | Predominantly unruptured, saccular, small (86%) aneurysms of ICA; mean neck diameter, 5 mm; mean neck/sac ratio, 0.8 | 88.0 | 2.5 | 0 | Briganti et al, 2017 ⁴ |
| Surpass Streamline | Retrospective, multicenter, case review | 39 | 48 | Unruptured, saccular aneurysms, mainly anterior (77%); median neck diameter, 3.4 mm | 85.0 ^b (12 mo) | 0 | 0 | Morais et al, 2017 ⁶ |
| — | Prospective, single-center, cohort study | 37 | 49 | Unruptured, complex aneurysms, predominantly saccular and ICA | 94.0 ^c | 3 | 0 | De Vries et al, 2013 ⁶² |
| — | Retrospective, multicenter, case review | 52 | 52 | Acutely ruptured or unruptured aneurysms of posterior circulation (29% + coiling) | 66.0 ^d | Not reported | 14.0 (Median follow-up, 11.3 mo) | Taschner et al, 2017 ⁶³ |
| Tubridge | Prospective, single-center, cohort study | 28 | 28 | Unruptured, large or giant ICA aneurysms | 72.0 ^e (Mean follow-up, 9.9 mo) | 0 (Follow-up ≤30 mo) | 0 (Follow-up ≤30 mo) | Zhou et al, 2014 ⁶⁴ |
| PARAT | Prospective, multicenter trial | 185 | 185 | Predominantly large ICA aneurysms, some of vertebral artery | 75.34% (Mean follow-up, 6 mo) | 2.4 | 1.61 | Liu et al, 2018 ⁶⁵ |
| eCLIPS | Prospective, first in man study and compassionate use Canada/EU cases | 25 ^x | 25 ^x | Bifurcation aneurysms, mostly of basilar artery tip (some previously coiled), most + coiling | 81.0 ^y (MRRC class I/II; average follow-up 8 mo) | Not reported | 8.0 (Average follow-up 8 mo) | Chiu et al, 2018 ⁷¹ |
| — | Retrospective, multicenter, case review | 24 | 34 | Wide-neck, mostly medium-sized and fusiform, predominantly anterior aneurysms | 71.4 ^z (3-mo follow-up), 77.8 ^{aa} (9-mo follow-up) | Not reported | 4.3 | Akgul et al, 2016 ⁶⁷ |

Note:—ITT indicates intention-to-treat; MRRC, modified Raymond-Roy classification.

^a Intracranial hemorrhage and/or ischemic stroke.

^b Forty-seven devices placed (152 per aneurysm); single PED used in 18 aneurysms.

^c One hundred five/107 treated patients received >1 device (median, 3; range, 1–15) per target aneurysm.

^d One hundred six aneurysms in 104 patients (4 patients excluded from effectiveness cohort, 2 patients had additional contralateral aneurysms treated).

^e Of 107 patients in safety cohort.

^f No hemorrhagic or ischemic stroke or death reported from 6 mo to 3 yr postprocedure.

^g Of 103 patients.

^h Aneurysm size not reported for 10 aneurysms.

ⁱ Of 24 patients (29 aneurysms), 12 at 3 mo and 12 at 6 mo.

^j Of 49 aneurysms evaluated at follow-up.

^k Of 77 patients.

^l Of 56 aneurysms.

^m Of 70 aneurysms.

ⁿ Of 82 aneurysms.

^o Of 78 aneurysms.

^p Of 30 aneurysms.

^q Of 36 aneurysms.

^r FRED-only 81.5%, 95.0% FRED + coiling.

^s Of 35 aneurysms.

^t Of 41 aneurysms.

^u Of 41 aneurysms.

^v Of 44 patients.

^w Of 25 aneurysms.

^x Twenty-five patients had successful device placement.

^y Of 21 patients with complete data.

^z N = 28 aneurysms in 20 patients.

^{aa} N = 18 aneurysms in 9 patients.