



Efficacy of Flow-Diverting Devices for Cerebral Aneurysms: A Systematic Review and Meta-analysis

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■ **BACKGROUND:** To evaluate the efficacy of flow-diverting devices (FDDs) used in the treatment for intracranial aneurysms (IAs), we performed a meta-analysis of published literature on FDDs.

■ **METHODS:** A systematic electronic database search was conducted using MEDLINE, PubMed, Springer, and EBSCO for all accessible articles on FDDs published until December 2014. Abstracts, full-text manuscripts, and the reference lists of retrieved articles were analyzed. Random effects meta-analysis was used to pool the occlusion rate outcomes across studies.

■ **RESULTS:** Fifty-nine studies containing efficacy data on 2263 patients with more than 2493 treated aneurysms were included in the analysis. The overall complete occlusion rate was 82.5% (95% CI, 78.8%–86%) across studies. The success rate of FDD implantation was 97.4% (95% CI, 95.4%–99.4%). The occlusion rate for anterior circulation aneurysms was 83.3% (95% CI, 71.2%–95.4%); with regard to complete occlusion, the odds ratio for anterior circulation aneurysms was significantly higher than that of posterior circulation IAs (odds ratio, 1.93; 95% CI, 1.00–3.73).

■ **CONCLUSIONS:** FDDs have high technical success rates in the management of IAs. Additional studies on well-designed, multicenter, randomized controlled trials will be required to validate the findings of the present study and to identify the best therapeutic strategy for IAs depending on their size, location, and characteristics.

BACKGROUND

The prevalence of intracranial aneurysms (IAs) as detected by magnetic resonance angiography was recently found to be 7%.¹ Given the high prevalence rate, successful management of IAs is crucial to reducing health burden. The goals of IA treatment are reconstruction of the cerebral vessels and modification of the hemodynamic status. However, conventional endovascular treatment yields low complete occlusion rates and high recurrence rates, especially in the management of large and giant aneurysms.^{2,3}

Flow-diverting devices (FDDs) are a groundbreaking invention with regard to IA treatment. Since their inception in 2007, FDDs have facilitated the use of an endoluminal approach rather than the endosaccular approach in the management of IAs.⁴ We conducted a systematic review and meta-analysis of the literature on aneurysm occlusion rate to evaluate the overall aneurysm occlusion rates for different patient cohorts.

METHODS

Data Collection

We adopted search strategies recommended in the Cochrane Handbook for Systematic Reviews of Interventions. The medical literature on FDDs for IAs was reviewed up to January 1, 2015. Title, abstract, key words, and free text were searched using combinations of the following terms: “intracranial aneurysm” or “cerebral aneurysm,” “endovascular,” and “flow diverter” or “flow diverting.” Also, the references from the publications obtained were checked for additional studies. The systematic literature search was performed by two investigators (G.Z. and M.S.).

Key words

- Efficacy
- Flow-diverting devices
- Intracranial aneurysm
- Occlusion

Abbreviations and Acronyms

- BA:** Basilar artery
- CC:** Cavernous carotid
- COR:** Complete occlusion rate
- FDD:** Flow-diverting device
- FU:** Follow-up
- IA:** Intracranial aneurysm
- NC:** Near complete occlusion rate
- PC:** Posterior circulation

VA: Vertebral artery

VBJ: Vertebrobasilar junction

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Table 1. Characteristics of Studies Included in the Meta-analysis

Author, Year	Type of Study	Number of Patients/ Aneurysms	Immediate Success Rate (%)	Last FU COR (%)	Last FU CO + NC (%)	Permanent Morbidity Rate (%)	Mean FU (months)	Site	Device
Agarwal et al., 2012	Retrospective	23/23	100	82.7 (19/23)	NA	4.3 (1/23)	6	IA	PED
Albuquerque et al., 2014	Prospective	17/17	100	64.7 (11/17)	82.4 (14/17)	5.9 (1/17)	11.8 (3–27)	PC	PED
Aydin et al., 2012	Retrospective	11/NA	100	82 (9/11)	NA	9 (1/11)	6	AC+PC	SILK
Barros Faria et al., 2011	Retrospective	23/23	90	87.5 (14/16)	NA	8.7 (2/23)	6 (1–18)	IA	PED
Berge et al., 2012	Retrospective	65/77	98.5	84.3 (59/70)	88.6 (62/70)	7.8 (5/64)	6–12	IA	SILK
Briganti et al., 2012	Retrospective	273/295	NA	85 (153/180)	NA	3.7 (10/270)	3	IA	PED+SILK
Briganti et al., 2012	Retrospective	35/39	97.1	92.1 (35/38)	NA	5.7 (2/35)	41 (24–62)	IA	PED+SILK
Burrows et al., 2014	Prospective	93/95	94	69 (63/92)	NA	1 (1/93)	12	IA	PED
Byrne et al., 2010	Prospective	70/70	96	49 (24/49)	75 (37/49)	4 (2/50)	3.9	IA	SILK
Chalouhi et al., 2013	Prospective	40/40	100	80 (31/39)	NA	5	7	AC	PED
Chan et al., 2011	Retrospective	9/13	100	69 (9/13)	NA	0	2–15	AC	PED
Çinar et al., 2013	Prospective	45/55	96.8	91.9 (34/37)	NA	0	5–28	AC+PC	PED
Çinar et al., 2013	Retrospective	7/7	85.7	100 (7/7)	100	0	6–12	Supr	PED
Cirillo et al., 2012	Consecutive	30/30	90	53.3 (16/30)	76.7 (23/30)	16.7 (5/30)	15–31	IA	SILK
Cirillo et al., 2010	Retrospective	9/9	100	44.4 (4/9)	7/9	11.1 (1/9)	6	AC	SILK
Deutschmann et al., 2012	Prospective	12/12	100	100 (12/12)	100	0	24	AC+PC	PED
Fischer et al., 2014	Retrospective	65/69	98.5	58 (39/67)	NA	5	27.4 (0.1– 51.1)	AC+PC	PED+SILK
Fischer et al., 2014	Consecutive	88/101	99	52 (47/90)	NA	6	10 (1–15)	IA	PED
Keskin et al., 2014	Retrospective	24/25	100	100 (25/25)	NA	1/24	8.6 (2–22)	IA	PED+SILK
Kim et al., 2014	Retrospective	23/24	100	74 (17/23)	87 (20/23)	13 (3/23)	6	Cav/ Par	PED
Kocer et al., 2014	Retrospective	33/37	100	78.8 (19/33)	NA	0	3.6 (1–12)	AC+PC	FRED
Kulcsár et al., 2010	Retrospective	12/12	100	58 (7/12)	NA	25 (3/12)	NA	BA	SILK
Lanzino, 2012	Matched-pair	21/22	NA	76.2 (16/21)	90.5 (19/21)	0	13.4 ± 6.9	Par	PED
Leonardi et al., 2011	Retrospective	25/25	100	NA	(15/25)	4 (1/25)	12	IA	SILK
Lin et al., 2013	Retrospective	41/53	95.5	66.7 (14/21)	85.7 (18/21)	2.3 (1/41)	4.0 ± 1.9	AC	PED
Lin et al., 2014	Retrospective	26/26	100	78.3 (18/23)	91.3 (21/23)	11.5 (3/26)	5.9	IA	PED
Lubicz et al., 2010	Prospective	29/34	90	69 (20/29)	72.5 (21/29)	15 (4/26)	3–6	IA	SILK
Lubicz et al., 2011	Prospective	20/27	100	84 (21/25)	88 (22/25)	10 (2/20)	6	AC+PC	PED
Lylyk et al., 2009	Prospective	53/63	97	94.4 (17/18)	94.4	0	5.9	CA	PED

FU, follow up; COR, complete occlusion rate; NC, near complete occlusion rate; IA, intracranial aneurysm; CC, cavernous carotid; VBJ, vertebrobasilar junction; AC, anterior circulation; BA, basilar artery; PC, posterior circulation; Cav, Cavernous; Par, Paraclinoid; Supr, supraclinoid.

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