AXS Vecta 0.071–0.074 Inch Aspiration Catheters for Mechanical Thrombectomy: Case Series and Literature Review

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Aspiration catheters are widely used for thrombectomy either alone or in combination with a stent-retriever, with a distal inner diameter and trackability keys to their success. In an illustrative case series, we report our clinical experience with AXS Vecta (Stryker Neurovascular, Fremont, CA, USA), available in both 0.071-inch and 0.074-inch distal inner diameters, including the first 2 Vecta 74 cases reported. A literature review on AXS Vecta is also provided. In our series, 9 thrombectomies were performed (Vecta 71: 2 M1, 5 M2 occlusions; Vecta 74: 1 M1 and 1 ICA-terminus occlusion). The AXS Vecta was successfully delivered to the target site in all cases. In 7 of 9 cases, the catheter was delivered over a Tenzing 7 delivery catheter (Route 92 Medical, San Mateo, CA, USA). For 2 of 9 combination approach cases, Vecta was delivered using the stent-retriever wire as a rail. The median improvement in NIHSS score during hospitalization was 9 (IQR 5–12). Successful mTICI 2C or 3 recanalization was achieved in 8 of 9 (89%) patients after a median 2 (IQR 1–2) passes. Our median groin-to-reperfusion time was 23 (IQR 12.5–32) minutes, with no procedural complications. Two previous clinical studies of a total of 29 patients treated with Vecta 71 reported successful mTICI 2b–3 recanalization in 89–90% of cases. The Median groin-to-reperfusion time was 30 minutes. Complications were seen in 2 of 29 (6.9%) cases (vessel perforation and/or intracerebral hemorrhage). These data support the efficacy, deliverability, and safety of AXS Vecta for mechanical thrombectomy.

Key Words: Stroke; Thrombectomy; Equipment and supplies; Ischemia

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INTRODUCTION

Several randomized clinical trials have shown the significant benefits of mechanical thrombectomy (MT) over medical management in patients presenting with acute stroke with large vessel occlusions (LVOs) with absent or small core infarcts.[1-7] The vast majority of thrombectomies in these trials were performed using stent-retriever (SR) devices. Since then, several alternative thrombectomy techniques have gained acceptance.

Aspiration thrombectomy using the a direct aspiration first pass technique (ADAPT) is an efficient and cost-effective means of rapidly restoring perfusion in LVO stroke patients.[8-10] The ADAPT technique relies on delivering an aspiration catheter to the proximal aspect of the embolus and applying suction

to the catheter to aspirate the embolus. The proposed advantages of the ADAPT technique over SRs include: a faster time to first pass, less need to pass microwires and delivery microcatheters into more distal artery branches beyond the embolus, decreased damage to the endothelial wall,[11] decreased vessel traction during device removal, decreased clot disruption, and decreased cost.[12] Two randomized trials, the contact aspiration *vs.* stent-retriever for successful revascularization (ASTER)[8] and a comparison of direct aspiration *vs.* stent-retriever as a first approach (COMPASS)[9] trials, compared SR and ADAPT techniques as first-line thrombectomy options. In both trials, SR and ADAPT techniques achieved similar rates of successful reperfusion and 90-day functional independence.[8,9] In addition, cost savings were achieved in the ADAPT cohort. These 2 randomized control trial (RCT), alongside a meta-analysis of 6 RCTs (871 patients), demonstrated that Solitaire SR and aspiration catheters have equal safety, providing sufficient evidence to recommend ADAPT as a reasonable first-line endovascular therapy (EVT) approach.[13]

SRs may also be used in combination with aspiration catheters to maximize clot retrieval forces at both the clot face and along its length. This combination technique is also widely utilized,[14,15] and may be advantageous in tortuous intracranial anatomy by optimizing the angle at which the SR is withdrawn ("line of force") and avoiding undesirable traction on the artery itself. Initial studies evaluating the combination technique have reported high recanalization rates (88% thrombolysis in cerebral ischemia [TICI] 2B or 3), a low number of passes, and good functional outcomes.[15-24]

Aspiration catheter design improvements over time have focused on larger inner diameter (ID) at the tip (for increased suction force), and improved catheter trackability (or deliverability) through tortuous anatomy. Use of larger catheters with ADAPT (0.070 inch or greater) may be associated with increased aspiration flow rates, first pass effect, faster recanalization, reduced procedure time, and better reperfusion rates,[25,26] compared to less sizes than 0.070. Currently, available aspiration catheter ID now range between 0.035 inches and up to 0.074 inches.[27-31] The AXS Vecta 71 and AXS Vecta 74 (Stryker Neurovascular, Fremont, CA, USA) aspiration catheters were recently approved for thrombectomy, with an ID of 0.071 inches and 0.074 inches, respectively. The Vecta 071 can be delivered through a 0.088-inch guide catheter or larger. The slightly larger Vecta 74 must be delivered through a 0.091-inch ID guide catheter (e.g., AXS INFINITY LS™ PLUS

Long Sheath; Stryker Neurovascular) or larger. Herein, we report our initial experience in 9 patients with AXS Vecta 71 and 74 for MT using aspiration and combination techniques for the purpose of assessing their safety and efficacy. In addition, we review current literature on AXS Vecta in acute ischemic stroke MT.

METHODS

Case Series
Using a prospective collected institutional stroke patient database, we retrospectively reviewed medical records of consecutive patients with stroke who underwent MT at our center with AXS Vecta 71 or 74 catheters between September 16, 2018, and May 16, 2022. All patients who received MT had evidence of LVO on computed tomography (CT) angiogram. Patient selection for thrombectomy was based on the most recent American Heart Association Guidelines.[13] We confirm that this study was an observational, minimal-risk study, and no patient informed consent was required as the research did not include any patient identifying information, per the California Pacific Medical Center (CPMC) Research Institute Policy. This study was approved by the CPMC Institutional Review Board (approved protocol 2.16.17).

Study Variables
Collected data for each patient included age, sex, race, stroke risk factors (hypertension, diabetes, hyperlipidemia, atrial fibrillation, smoking), time of symptom onset, stroke severity on arrival measured by the National Institutes of Health Stroke Scale (NIHSS), baseline functional status as measured by modified Ranking Scale (mRS) before symptom onset, intravenous (IV) thrombolytic use, and time of groin puncture. Patient imaging included admission CT. Admission CT angiography was reviewed to document the admission Alberta stroke program early CT score (ASPECTS) and the location of the vascular occlusion. Angiography, procedure reports, and follow-up CT or magnetic resonance imaging (MRI) were reviewed to document outcome variables including number of passes, reperfusion time, procedural complications, rate of symptomatic intracerebral hemorrhage (sICH) transformation, and discharge NIHSS. Procedural complications and final reperfusion score using the modified TICI (mTICI) grading scale were used to document pre-thrombectomy occlusion and post-thrombectomy revascularization. sICH was defined

using the European Australian Cooperative Acute Stroke Study II definition as any intracerebral hemorrhage on any posttreatment imaging after the start of tissue plasminogen activator with an increase of ≥4 points in NIHSS score.[32]

Technique

Thrombectomy procedures were performed by 1 of 3 experienced neurointerventionists (JDE, WTK, and FS). In brief, vascular access was obtained using a 9-French femoral sheath. A large guide catheter, (e.g., Infinity Long Sheath [Stryler Neurovascular], was advanced into the distal cervical segment of the internal carotid artery. In this series, for combination SR+local aspiration (cases 1–2), the AXS Vecta catheters were delivered in a coaxial fashion over a Prowler Plus (Cordis Neurovascular, Miami, FL, USA) microcatheter and a 0.014-inch Synchro2 Standard microwire (Boston Scientific Corp., Marlborough, MA, USA). In these combination technique cases, the stent-retriever was deployed first, and then the aspiration catheter was brought to the face of the clot (or to the M1 segment, if presenting as an M2 occlusion)[14,15] using the SR wire as a rail. The ADAPT technique has been described in previous reports.[33] For aspiration thrombectomy (ADAPT) cases 3–9, the Vecta catheter was delivered using a shelf-re-ducing Tenzing 7 delivery catheter (Route 92 Medical, San Mateo, CA, USA) without a leading microwire. The delivery catheter was then removed, and aspiration was applied with a vacuum aspiration pump for 3–5 minutes before pulling the aspiration catheter back until free blood return was observed in the aspiration tubing. If no free flow was seen in the tubing, the catheter was completely removed from the patient.

Statistical Analyses

Descriptive statistics were used to report patient demographics and clinical characteristics of the included patients. The analysis was conducted using SPSS v25 (IBM Corp., Armonk, NY, USA).

Literature Review

An extensive online literature search was performed to identify other studies reporting the use of AXS Vecta aspiration catheters in MT. Online databases available through our institution, including PubMed and Medline, were searched using keywords: "Vecta" and "Thrombectomy" and "Stroke". We reviewed angiographic data from both English and non-English studies. Study variables include median age, sex, base-

Table 1. Patient proceduraland outcome data

Case no.	NIHSS	IV-tPA	Location of LVO	Initial mTICI score	Final mTICI score	Time from groin puncture to reperfusion, minutes	Discharge NIHSS	Technique	Number of passes
1	4	No	Proximal L M2	2A	2C	68	1	Combination: Trevo XP 4x20+Vecta 71	4
2	16	Yes	R M1	0	2C	8	7	Combination: Trevo XP 6x30+Vecta 71	2
3	11	No	Proximal R M2	2A	2C	17	0	ADAPT: Vecta 71	2
4	15	No	R M1	0	3	59	6	ADAPT: Vecta 74	1
5	9	No	Proximal L M2	2A	3	29	3	ADAPT: Vecta 71	4
6	20	Yes	Proximal L M2	2A	3	33	2	ADAPT: Vecta 71	2
7	27	No	Proximal R M2	2A	3	11	*	ADAPT: Vecta 71	1
8	5	Yes	R M1	0	0	NA	20	ADAPT: Vecta 71	2
9	24	Yes	L ICA-T	0	2C	13	9	ADAPT: Vecta 74	1

NIHSS, National Institutes of Health Stroke Scale; IV-tPA, intravenous tissue plasminogen activator; LVO, large vessel occlusion; mTICI, modified thrombolysis in cerebral ischemia score; L, left; R, right; ICA-T, internal carotid artery terminus occlusion; NA, not available; ADAPT, a direct aspiration first pass technique.
*Deceased due to respiratory problems.

line non-contrast CT ASPECTS, IV thrombolytic use, occlusion site, procedural technique, device, mean/median number of passes, mean/median procedural time, successful recanalization according to modified treatment in cerebral ischemia score (mTICI 2b–3, >50% reperfusion of the target vessel) after the first pass, complete recanalization (mTICI 2c–3) within a single attempt (first-pass effect), overall procedural success (mTICI 2b–3 and 2c–3), rate of complications, and functional outcomes (improvement in NIHSS at either post-procedure day 1 or at discharge).

RESULTS

Case Series

Nine consecutive patients underwent thrombectomy using

the AXS Vecta catheters at our institution during the study period. Table 1 summarizes the characteristics of the included patients. The mean age was 65 (standard deviation 19.9) years, 4 of 9 were female, 4 of 9 were Caucasian, 3 of 9 were Hispanic, and 2 of 9 were Asian. The most common stroke risk factor was hypertension (in 7 of 9) followed by atrial fibrillation (in 3 of 9), and hyperlipidemia (in 3 of 9). The baseline mRS was in the range 0–1 for all patients, except 1 that had a baseline mRS of 3. The median ASPECTS was 7 (interquartile range [IQR] 5–9). The median last known well to groin puncture time was 409 (IQR 260–500) minutes.

Seven of 9 cases were performed using the Vecta 71 catheter and 2 of 9 were performed with the Vecta 74 aspiration catheter (Fig. 1). The ADAPT technique was utilized in 7 of 9 cases, with the catheter delivered over a Tenzing 7 delivery catheter (Route 92 Medical) (Fig. 1). For 2 of 9 combination
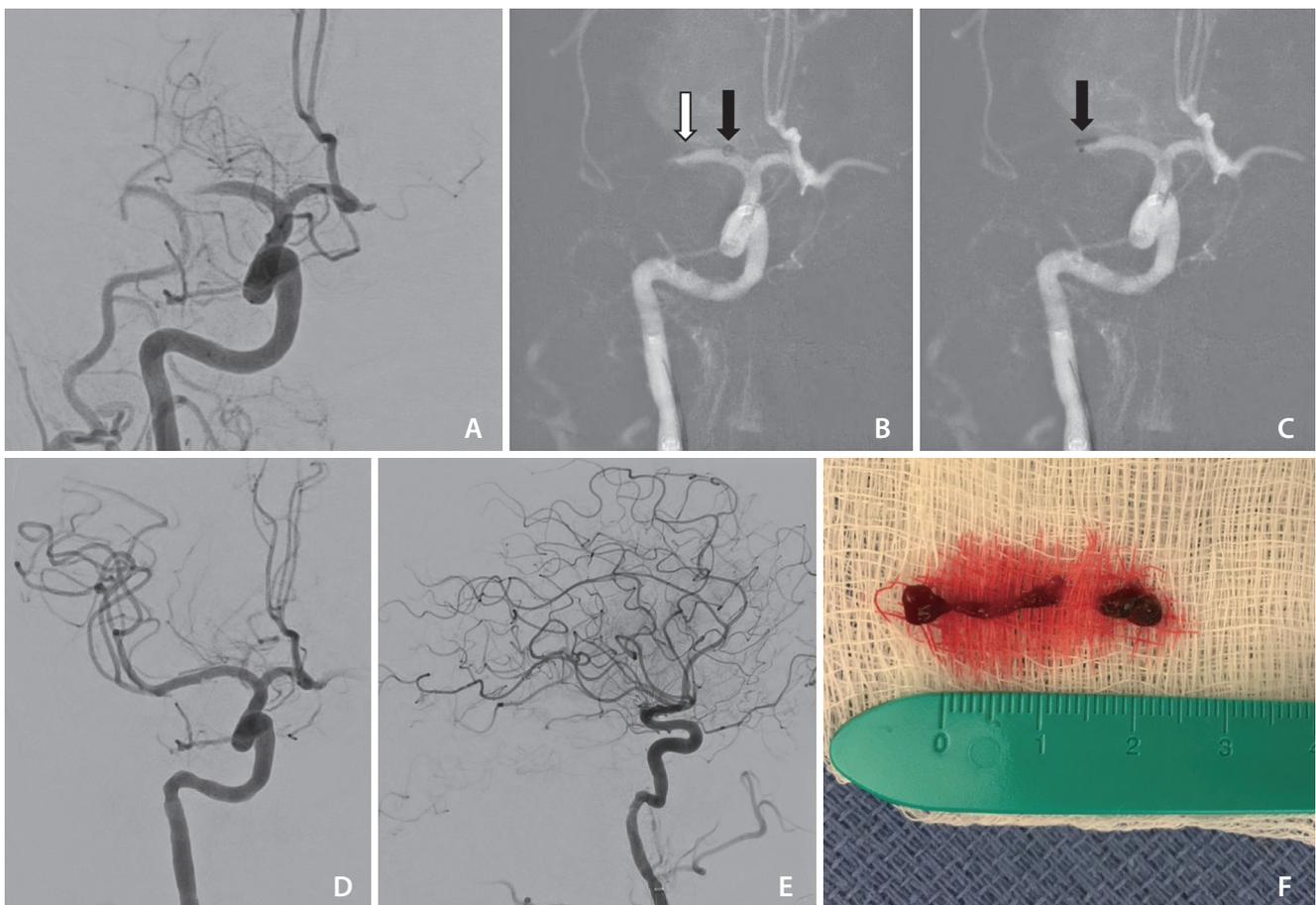

Fig. 1. (**A**) Initial cerebral angiogram showing an occlusion at the M1 segment of the right middle cerebral artery. (**B**, **C**) The delivery of the AXS Vecta 74 catheter (Stryker Neurovascular, Fremont, CA, USA) (black arrows) to the occlusion site over a Tenzing 7 delivery catheter (Route 92 Medical, San Mateo, CA, USA) (white arrow). (**D**, **E**) Final cerebral angiography imaging showing successful recanalization (mTICI score 3). (**F**) Photo of retrieved thrombus. mTICI, modified thrombolysis in cerebral ischemia score.

approach cases, the Vecta was delivered using the SR wire as a rail.

Successful reperfusion (mTICI ≥2B) was achieved after a median of 2 passes (IQR 1–2). The median groin puncture to reperfusion time was 23 (IQR 12.5–32) minutes. The AXS Vecta catheters demonstrated excellent navigability and tractability, which aided in achieving mTICI 2C or 3 in all cases except case 8. Case 8 had a final mTICI of 0. Although the Vecta 71 achieved initial full reperfusion, the middle cerebral artery (MCA) quickly re-occluded due to underlying an underlying atherosclerotic plaque. Rescue therapy with IV GPIIB/IIIA inhibitor +/– stenting was not performed due to the

presence of a nonspecific hyperdense pontine lesion on the initial pre-procedure CT (differential diagnosis included acute hemorrhage, hemorrhagic neoplasm, or cavernous malformation) and risk subsequent life-threatening hemorrhage. Unfortunately, by the time an MRI was performed to further characterize the pontine lesion, a large core infarct had developed in the right MCA territory. The median improvement in NIHSS at discharge, excluding 1 patient that died during hospitalization from pneumonia, was 9 (IQR 5–12).

No vessel perforation, dissection, or other procedural complications were identified during or after any of the procedures. None of the patients had sICH following the pro-

Table 2. Summary of clinical studies of thrombectomy using Vecta

Demographics and procedural data	Reference study		
	Gross et al.[31] (2019)	Almallouhi et al.[34] (2019)	Current study
Catheter used	Vecta 71	Vecta 71	Vecta 71 and 74
No. of patients	19	10	9
Median/mean age	NR	76.2 (5.83)	68 (IQR 60–74)
Sex, female	NR	4/10	4/9
Baseline non-contrast CT ASPECTS	NR	7.5 (IQR 7–8.75)	7 (IQR 5–9)
IV thrombolytic	1/19	9/10	4/9
Occlusion location			
ICA	6/19 (32)	0/10	1/9
M1	11/19 (58)	4/10	3/9
Proximal M2	0/19	6/10	5/9
Basilar	2/19 (11)	0/10	0/9
Technique			
Catheter reached clot	19/19 (100)	9/10	9/9 (100)
Stentriever needed to reach clot	1/19 (5)	0/10	2/9 (22)
Empiric stentriever used	5/19 (26)	0/10	2/9 (22)
Catheter reached clot, no stentriever	13/14 (93)	9/10	7/9 (78)
Mean/median number of passes	2.6 (2.0)	2	2 passes (IQR 1–2)
Single pass cases	8/19 (42)	NR	3/9 (33)
Mean/median procedural time (min)	42 (32)	29.5 (IQR 14.3–53.3)	23 (IQR 12.5–32)
FPE (mTICI 2b–3)	9/19 (47)	NR	
FPE (mTICI 2c–3)	NR	NR	
Successful recanalization (mTICI 2b-3)	17/19 (89)	9/10 (90)	8/9 (89)
Complete recanalization (mTICI 2c–3)	NR	4/10	8/9 (89)
Complications	2/19 (11)	0	0
Mean improvement in NIHSS, post-procedural day 1	8 (7.0)	NR	NR
Mean/median improvement in NIHSS at discharge	NR	9.9 (4.9)	9 (IQR 5–12)
Mortality within available follow-up period	6/19 (32)	NR	1/9

Values are presented as number only or number (%).
CT, computed tomography; ASPECTS, Alberta stroke program early CT score; IV, intravenous; ICA, internal carotid artery; FPE, first pass effect; mTICI, modified treatment in cerebral ischemia; NIHSS, National Institutes of Health Stroke Scale; NR, not reported; IQR, interquartile range.

cedure. One patient died post-procedure due to respiratory failure.

Literature Review

Two clinical studies (with a total of 29 cases)[31,34] who underwent MT with AXS Vecta 71 catheters were identified in the literature and reviewed. Demographics, procedural data, and outcomes are presented in Table 2 and are compared to the current study. No studies were found that reported on the use of Vecta 74.

Gross et al.[31] reported on 19 patients who underwent thrombectomy using Vecta 71 on the first pass as part of a larger study (a total of 59 patients) comparing the efficacy and safety with 2 other aspiration catheters (React 71 [Medtronic, Irvine, CA, USA] and 0.072-inch Jet 7 [Penumbra, Alameda, CA, USA]).[31] Clinically, the mean improvement in NIHSS score on the first post-treatment day (8±7.0) for patients in the Vecta group was not different in comparison with the other 2 groups (P=0.16). Overall, similar angiographic results were noted using all 3 0.071-inch and 0.072-inch large-bore aspiration catheters (final mTICI 2b–3 achieved in 92% of cases overall: 95% with React 71, 89% with Jet 7, and 89% with Vecta 71). Excluding empiric stentriever usage, the aspiration catheter could be delivered to the clot without needing a stentriever in 87% of cases overall: 100% with React 71, 93% with Vecta 71, and 43% with Jet 7 (P=0.002), indicating that React 71 and Vecta 71 tracked more reliably to the clot over a microcatheter as compared with the Jet 7 catheter. In addition, procedure-related complications (perforation or hemorrhage) were seen in 4 of 49 patients (8%): 1 of 21 React 71 cases, 2 of 19 Vecta 71 cases, and 1 of 19 Jet 7 cases. Procedural times were similar across groups. Of note, 12 of 49 (24%) patients died within the available follow-up period; this rate did not significantly differ between the 3 groups.

Almallouhi et al.[34] reported on 10 patients who underwent thrombectomy using Vecta 71 with the ADAPT technique. Nine out of 10 (90%) received IV tissue plasminogen activator before thrombectomy. The median ASPECTS was 7.5 (IQR 7–8.75). The median symptom onset to groin puncture time was 261.5 (IQR 252.25–303.25) minutes. Successful reperfusion (mTICI 2b or 3) was achieved with 1–3 aspiration attempts in all cases except for 1 case (4 aspiration attempts and stent-retriever attempts were unsuccessful due to underlying severe intracranial atherosclerosis). The authors were able to deliver the AXS Vecta to the target in 9 of 10 cases, except in 1 case where the AXS Vecta could not be advanced past the M1 because of the small caliber secondary to atherosclerosis. The median groin puncture to reperfusion time was 29.5 (IQR 14.25–53.25) minutes. None of the patients suffered sICH following the procedure.

DISCUSSION

Previously published data suggest that the Vecta 71 catheter can be used to perform rapid, effective, and safe MT.[31,34] Our series of patients treated with Vecta catheters resulted in successful revascularization in a similar proportion of cases as previously published studies (89%), using both ADAPT and the SR plus a local aspiration technique, without complications (Table 2). Clinical outcomes seen with Vecta 71 and 74 in our series were also similar to these previously published in Vecta 71 reports[31,34] (Table 2). The AXS Vecta catheter reached the clot in nearly every case across the studies. As reported by Gross et al.,[31] Vecta 71 and React 71 tracked particularly better than Jet 7, as clot access in the Jet 7 group required a different use of alternate catheters (2 of 9 patients) or use of a SR as a rail (2 of 9 patients).

The median number of passes in our study, 2, was similar to prior reports, with similar first pass effect rates (42% vs. 33%). There was a higher proportion of proximal M2 occlusions in our study, 5 of 9 (56%) patients, compared to 0 patients with M2 occlusions in Gross et al.[31] Almallouhi et al.[34] had 6 of 10 (60%) cases of M2 occlusions. MT of M2 occlusions requires anatomical considerations: the caliber of the M2 branch (such as a dominant inferior division M2 segment) must be large enough to accommodate a large bore aspiration catheter and the tortuosity and acuity of the angle of the M1 MCA bifurcation must permit a large bore aspiration catheter to take a turn without causing a dissection or perforation. As a result, the use of large bore aspiration catheters is limited to cases with a favorable anatomy.

The median groin-to-reperfusion time of 23 minutes in our study was more rapid than previously reported for Vecta 71.[31,34] This is likely due to our use of a Tenzing 7 delivery catheter (Route 92 Medical), which significantly reduces the space between an inner microcatheter and outer aspiration catheter or ledge. This is especially important with the increasing caliber of aspiration catheters, which have a greater tendency to catch on the ophthalmic artery origin and have increased friction in tortuous anatomy. A ledge-reducing delivery catheter provides a more robust rail in the center of the

vessel lumen. In an *in vitro* study, we previously showed that the Tenzing 7 is capable of delivering aspiration catheters to the proximal M1 in half the time compared to a leading microwire/microcatheter.[35] For similar reasons, such delivery catheters may also improve access to proximal M2 MCA occlusions (4 of 7 ADAPT cases in our series were proximal M2 occlusions). Ledge-reducing delivery catheters, such as the Tenzing 7 or AXS Offset (Stryker Neurovascular)[36] may also be less disruptive to the clot and less likely to induce thrombus fragmentation and distal embolization. When using the ADAPT technique as a first-line approach, difficulty may be encountered in delivering an aspiration catheter to a thrombo-embolus due to a number of factors, such as vascular tortuosity, intracranial atherosclerotic disease, small native vessel caliber, or ophthalmic artery origin anatomy. In such cases, the use of a stentriever anchoring technique may be considered. After stentriever deployment, the stentriever wire functions as a rail and is more centered in the vessel lumen compared to a 0.021–0.035 inch microcatheter, minimizing the ledge effect.

A number of physical properties contribute to the efficacy of a thrombectomy aspiration catheter: ID, navigability and trackability, kink and ovalization resistance, and catheter tip distensibility. A recent study compared the *in vitro* navigability and trackability of various large aspiration catheters when advancing over a microcatheter/microwire support system through a sinusoidal glass vascular anatomy model.[37] This study, however, included an older generation Cat 7 aspiration instead of the Vecta 71 catheter. The Cat 7 catheter uses a continuous nitinol round wire wind, while the Vecta catheter features a supportive braided proximal stainless steel coil shaft (for enhanced pushability) and a nitinol coil on the approximately distal 10.8 cm of the catheter (for enhanced flexibility and durability). These properties provide smoother catheter navigation with both a microcatheter/microwire

and stentriever anchoring techniques.

In our series, we were able to track the Vecta catheters to the target site in each case, as distally as the proximal M2 segment MCA, indicating that the Vecta 71 catheter can be navigated to this distal location in some cases. It is important, however, that operators using a catheter of this size for ADAPT recognize that in patients who have significant intracranial atherosclerotic disease, these catheters may be too large to maneuver to or through the M1 segment. Moreover, in some cases utilizing ADAPT as a first line approach, the combination of a stent-retriever and aspiration catheter may be necessary to retrieve emboli that are resistant to initial direct aspiration passes. Additional characteristics differentiate the Vecta from other available large bore aspiration catheters (Table 3) include a non-tapering distal tip, a low profile distal outer diameter (for 0.070–0.072 catheters), and an option to use a larger version (Vecta 74).

This is also the first report of 2 clinical cases of aspiration thrombectomy using the Vecta 74 catheter. Direct aspiration thrombectomy requires an aspiration force strong enough to successfully engage, engulf, and remove the thrombus. The ADAPT technique was initially described with aspiration catheters having a 0.054–0.060 inch ID.[33] In the ADAPT arm of the ASTER trial, aspiration catheters used included Penumbra ACE64 (65/174, 37%) or smaller catheters (5MAX, ACE60, Sofia).[8] The COMPASS trial used the Penumbra ACE68 (57%, 76/134) or ACE64 (30%, 40/134). Neither trial included patients treated with 0.070 inch or larger distal ID catheters, however, since these were not yet commercially available. Since then, several studies comparing larger and smaller bore aspiration catheters have shown improved outcomes, shorter procedure times, and a lower likelihood of using additional devices without impacting complication rates with a larger bore.[25,38] This relates not only to increased suction force at clots with larger IDs, but

Table 3. Comparison of specifications of large bore-aspiration catheters

Specification	AXS Vecta 71	AXS Vecta 74	React 71	Sofia Plus	Jet 7
Catheter tip edge	Non-tapered	Non-tapered	Angled	Non-tapered	Angled
Inner diameter (inch)	0.071	0.074	0.071	0.070	0.072
Distal outer diameter (mm)	2.08	2.11	2.17	2.08	2.16
Recommended minimum guide catheter inner diameter	0.088 inch (2.24 mm)	0.091 inch (2.31 mm)	0.091 inch (2.31 mm)	0.091 inch (2.31 mm)	0.091 inch (2.31 mm)

AXS Vecta: Stryker Neurovascular, Fremont, CA, USA; React 71: Medtronic, Irvine, CA, USA; Sofia Plus: MicroVention Terumo, Tustin, CA, USA; Jet 7: Penumbra, Alameda, CA, USA.

also increased aspiration flow rate with decreasing catheter size to vessel diameter ratio.[26] Consequently, design and engineering improvements have permitted a trend in increasing catheter distal ID without clinically significant sacrifices in navigability, pushability, and durability in most instances.[39] The Vecta 74 represents a further step in this trend. This catheter shares the same design characteristics and materials as the Vecta 71, but with a slightly larger inner and outer diameter (see Table 3). The vendor states that this larger outer diameter of Vecta 74 requires the use of a slightly larger guide catheter, such as the Infinity LS Plus Long Sheath (Stryker Neurovascular), which has a 0.091 ID but still goes through an 8F vascular sheath.

Several other large bore aspiration catheters (0.070–0.074) are currently available from different vendors: React 68 and 71 (Medtronic, Minneapolis, MN, USA), Sofia Plus (MicroVention Terumo, Tustin, CA, USA), as well as Jet 7, and more recently RED72 (Penumbra). The construction of all of these catheters shows a high degree of similarity, with all catheters featuring the following: (1) inner polytetrafluoroethylene (or Teflon) liner; (2) hybrid reinforcement using a proximal braided coil (for pushability, torquability, and kink/ovalization resistance) and a distal non-braided coil (for flexibility through tortuous anatomy); (3) blended polymer jackets of varying/ transitioning stiffness along the catheter shaft; and (4) outer hydrophilic coating (for reducing friction). Subtle specification differences between catheters exist (Table 3). Studies of clinical experience with these catheters has yielded similar rates of efficacy (reperfusion rates, number of passes, procedure times, outcomes), and safety (procedural complications) to AXS Vecta 71.[27,40-42] There are no published clinical studies utilizing RED72 catheters at this time.

A recent *in vitro* study[43] compared the navigation performance in a glass phantom model mimicking tortuous vascular anatomy for the following different large bore aspiration catheters: Vecta 74, Cat 6, ACE 68, Jet 7 (Penumbra), React 68 and React 71 (Medtronic), and Sofia Plus (MicroVention Terumo, Tustin, CA, USA). Similar tracking forces were needed for Vecta 74 catheter advancement using unsupported advancement compared to other catheters. When tracking over a microcatheter/microwire or stentriever wire, however, slightly higher tracking force was needed for Vecta 74 compared to all other catheters except the ACE 68. To date, however, no *in vitro* study has compared tracking forces across different aspiration catheters when using a delivery assist catheter. Such delivery catheters, including Tenzing (Route 92 Medical), Offset (Stryker Neurovascular), and Wedge (MicroVention Terumo), will very likely reduce gaps in tracking forces between different aspiration catheters.[35,36,44] Further increases in aspiration catheter ID may be desirable from a suction force perspective. However, there are potential disadvantages as catheters become larger and begin to asymptotically approximate the caliber of the large artery itself, including increased friction in the artery and risk of endothelial damage leading to arterial vasospasm, dissection, and/or perforation.

This study is limited by a relatively small number of clinical studies of Vecta 71 catheters available for review and the absence of prior Vecta 74 clinical studies. Our case series is limited by the single-center design and the small sample size. Larger scale retrospective or prospective studies are necessary to confirm the initial findings and detect potential complications of using Vecta catheters. Future *in vitro* studies comparing aspiration catheters from different vendors should also include Vecta catheters and delivery assist catheters.

In this early experience with the Vecta 0.071–0.074 inch aspiration catheters, successful reperfusion was achieved in 89% of patients within a fast reperfusion time and without procedural complications, similar to prior reports. Larger studies are needed to confirm the findings and further assess the efficacy and safety of the Vecta 74 aspiration catheter.

Fund

Ethics Statement

Ethics approval was obtained from the Institutional Review Board of California Pacific Medical Center (approved protocol 2.16.17). Due to the retrospective nature of the study, the need for patient informed consent was waived. As any information such as sex or age is not included, Informed consent for publication is not required.

Conflicts of Interest

FS reports consulting fees, grant, and honoraria from Stryker; consulting fees from Route 92 Medical; grant from MicroVention. WTK reports an equity interest in and consulting fees from Route 92 Medical, as well as consulting fees from Stryker. JDE reports an equity interest in and consulting fees from Route 92 Medical, as well as consulting fees from Stryker.

Author Contributions

Concept and design: FS. Analysis and interpretation: FS, WTK, and JDE. Data collection: FS and JDE. Writing the article: FS. Critical revision of the article: FS, WTK, and JDE. Final approval of the article: FS, WTK, and JDE. Statistical analysis: FS. Overall responsibility: FS.

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REFERENCES

1. Albers GW, Marks MP, Kemp S, Christensen S, Tsai JP, Ortega-Gutierrez S, et al.; DEFUSE 3 Investigators. Thrombectomy for stroke at 6 to 16 hours with selection by perfusion imaging. *N Engl J Med* 2018;378:708-718

2. Berkhemer OA, Fransen PS, Beumer D, van den Berg LA, Lingsma HF, Yoo AJ, et al.; MR CLEAN Investigators. A randomized trial of intraarterial treatment for acute ischemic stroke. *N Engl J Med* 2015;372:11-20

3. Campbell BC, Mitchell PJ, Kleinig TJ, Dewey HM, Churilov L, Yassi N, et al.; EXTEND-IA Investigators. Endovascular therapy for ischemic stroke with perfusion-imaging selection. *N Engl J Med* 2015;372:1009-1018

4. Goyal M, Demchuk AM, Menon BK, Eesa M, Rempel JL, Thornton J, et al.; ESCAPE Trial Investigators. Randomized assessment of rapid endovascular treatment of ischemic stroke. *N Engl J Med* 2015;372:1019-1030

5. Jovin TG, Chamorro A, Cobo E, de Miquel MA, Molina CA, Rovira A, et al.; REVASCAT Trial Investigators. Thrombectomy within 8 hours after symptom onset in ischemic stroke. *N Engl J Med* 2015;372:2296-2306

6. Nogueira RG, Jadhav AP, Haussen DC, Bonafe A, Budzik RF, Bhuva P, et al.; DAWN Trial Investigators. Thrombectomy 6 to 24 hours after stroke with a mismatch between deficit and infarct. *N Engl J Med* 2018;378:11-21

7. Saver JL, Goyal M, Bonafe A, Diener HC, Levy EI, Pereira VM, et al.; SWIFT PRIME Investigators. Stent-retriever thrombectomy after intravenous t-PA vs. t-PA alone in stroke. *N Engl J Med* 2015;372:2285-2295

8. Lapergue B, Blanc R, Gory B, Labreuche J, Duhamel A, Marnat G, et al.; ASTER Trial Investigators. Effect of endovascular contact aspiration vs stent retriever on revascularization in patients with acute ischemic stroke and large vessel occlusion: the ASTER randomized clinical trial. *JAMA* 2017;318:443-452

9. Turk AS 3rd, Siddiqui A, Fifi JT, De Leacy RA, Fiorella DJ, Gu E, et al. Aspiration thrombectomy versus stent retriever thrombectomy as first-line approach for large vessel occlusion (COMPASS): a multicentre, randomised, open label, blinded outcome, non-inferiority trial. *Lancet* 2019;393:998-1008

10. Turk AS, Spiotta A, Frei D, Mocco J, Baxter B, Fiorella D, et al. Initial clinical experience with the ADAPT technique: a direct aspiration first pass technique for stroke thrombectomy. *J Neurointerv Surg* 2014;6:231-237

11. Peschillo S, Diana F, Berge J, Missori P. A comparison of acute vascular damage caused by ADAPT versus a stent retriever device after thrombectomy in acute ischemic stroke: a histological and ultrastructural study in an animal model. *J Neurointerv Surg* 2017;9:743-749

12. Turk AS, Turner R, Spiotta A, Vargas J, Holmstedt C, Ozark S, et al. Comparison of endovascular treatment approaches for acute ischemic stroke: cost effectiveness, technical success, and clinical outcomes. *J Neurointerv Surg* 2015;7:666-670

13. Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2019;50:e344-e418

14. Deshaies EM. Tri-axial system using the solitaire-FR and penumbra aspiration microcatheter for acute mechanical thrombectomy. *J Clin Neurosci* 2013;20:1303-1305

15. Humphries W, Hoit D, Doss VT, Elijovich L, Frei D, Loy D, et al. Distal aspiration with retrievable stent assisted thrombectomy for the treatment of acute ischemic stroke. *J Neurointerv Surg* 2015;7:90-94

16. Mokin M, Ionita CN, Nagesh SV, Rudin S, Levy EI, Siddiqui AH. Primary stentriever versus combined stentriever plus aspiration thrombectomy approaches: in vitro stroke model comparison. *J Neurointerv Surg* 2015;7:453-457

17. Lee JS, Hong JM, Lee SJ, Joo IS, Lim YC, Kim SY. The combined use of mechanical thrombectomy devices is feasible for treating acute carotid terminus occlusion. *Acta Neurochir (Wien)* 2013;155:635-641

18. Wong J, Telischak N, Heit J, Moraff A, Dodd R, Do H, et al. E-083 Acute stroke intervention for large vessel occlusion with combined stent retriever and suction thrombectomy (Solumbra technique): a retrospective analysis of 85 patients. *J NeuroInter-*

ventional Surg 2016;8:A86

19. Stampfl S, Pfaff J, Herweh C, Pham M, Schieber S, Ringleb PA, et al. Combined proximal balloon occlusion and distal aspiration: a new approach to prevent distal embolization during neuro-thrombectomy. *J Neurointerv Surg* 2017;9:346-351

20. McTaggart RA, Tung EL, Yaghi S, Cutting SM, Hemendinger M, Gale HI, et al. Continuous aspiration prior to intracranial vascular embolectomy (CAPTIVE): a technique which improves outcomes. *J Neurointerv Surg* 2017;9:1154-1159

21. Massari F, Henninger N, Lozano JD, Patel A, Kuhn AL, Howk M, et al. ARTS (aspiration-retriever technique for stroke): initial clinical experience. *Interv Neuroradiol* 2016;22:325-332

22. Maus V, Behme D, Kabbasch C, Borggrefe J, Tsogkas I, Nikou-bashman O, et al. Maximizing first-pass complete reperfusion with SAVE. *Clin Neuroradiol* 2018;28:327-338

23. Maegerlein C, Mönch S, Boeckh-Behrens T, Lehm M, Hedderich DM, Berndt MT, et al. PROTECT: PRoximal balloon Occlusion TogEther with direCt Thrombus aspiration during stent retriever thrombectomy - evaluation of a double embolic protection approach in endovascular stroke treatment. *J Neurointerv Surg* 2018;10:751-755

24. Maegerlein C, Berndt MT, Mönch S, Kreiser K, Boeckh-Behrens T, Lehm M, et al. Further development of combined techniques using stent retrievers, aspiration catheters and BGC: the PROTECTPLUS technique. *Clin Neuroradiol* 2020;30:59-65

25. Alawieh A, Chatterjee AR, Vargas J, Chaudry MI, Lena J, Turner R, et al. Lessons learned over more than 500 stroke thrombectomies using ADAPT with increasing aspiration catheter size. *Neurosurgery* 2020;86:61-70

26. Kyselyova AA, Fiehler J, Leischner H, Flottmann F, Buhk JH, Frölich AM. Vessel diameter and catheter-to-vessel ratio affect the success rate of clot aspiration. *J Neurointerv Surg* 2021;13:605-608

27. Amireh AO, Kuybu O, Adeeb N, Kelley RE, Javalkar V, Cuellar H, et al. Utilization of the large-bore Penumbra JET 7 reperfusion catheter in thrombectomy for acute ischemic stroke: a single-center experience. *Interv Neuroradiol* 2021;27:99-106

28. Shallwani H, Shakir HJ, Rangel-Castilla L, Davies JM, Sonig A, Sattur MG, et al. Safety and efficacy of the Sofia (6F) PLUS distal access reperfusion catheter in the endovascular treatment of acute ischemic stroke. *Neurosurgery* 2018;82:312-321

29. Settecase F. 3MAX catheter for thromboaspiration of downstream and new territory emboli after mechanical thrombectomy of large vessel occlusions: initial experience. *Interv Neuroradiol* 2019;25:277-284

30. Gross BA, Hudson JS, Tonetti DA, Desai SM, Lang MJ, Jadhav

AP, et al. Bigger is still better: a step forward in reperfusion with react 71. *Neurosurgery* 2021;88:758-762

31. Gross BA, Jadhav AP, Jovin TG, Jankowitz BT. Clinical comparison of new generation 0.071-inch and 0.072-inch aspiration catheters. *World Neurosurg* 2019;130:e463-e466

32. Hacke W, Kaste M, Fieschi C, von Kummer R, Davalos A, Meier D, et al. Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). Second European-Australasian acute stroke study investigators. *Lancet* 1998;352:1245-1251

33. Turk AS, Frei D, Fiorella D, Mocco J, Baxter B, Siddiqui A, et al. ADAPT FAST study: a direct aspiration first pass technique for acute stroke thrombectomy. *J Neurointerv Surg* 2014;6:260-264

34. Almallouhi E, Anadani M, Al Kasab S, Lena JR, Spiotta AM. Initial experience in direct aspiration thrombectomy using a novel 0.071-inch aspiration catheter. *World Neurosurg* 2019;126:272-275

35. Frölich AM, Kim W, Stribrny K, Jansen O, Möhlenbruch M, Szikora I, et al. The novel Tenzing 7 delivery catheter designed to deliver intermediate catheters to the face of embolus without crossing: clinical performance predicted in anatomically challenging model. *J Neurointerv Surg* 2021;13:722-726

36. Pfaff JAR, Siekmann R, Shah YP, Ringleb PA, Ulfert C, Koller K, et al. Delivery assist catheters: a new device class and initial experience in mechanical thrombectomy in acute ischemic stroke patients. *Clin Neuroradiol* 2019;29:661-667

37. Reymond P, Brina O, Girdhar G, Bolanos O, Lovblad KO, Machi P. Experimental evaluation of the performance of large bore aspiration catheters. [published online ahead of print Feb 19, 2022] *J Neuroradiol* 2022

38. Pérez-García C, Maegerlein C, Rosati S, Rüther C, Gómez-Escalonilla C, Zimmer C, et al. Impact of aspiration catheter size on first-pass effect in the combined use of contact aspiration and stent retriever technique. *Stroke Vasc Neurol* 2021;6:553-560

39. Pearly Ti J, Yeo L, Anil G. Can a stent retriever damage the JET 7 reperfusion catheter? *AJNR Am J Neuroradiol* 2020;41:2317-2319

40. Li J, Ribo M. REACT aspiration catheters: clinical experience and technical considerations. *Neurointervention* 2022;17:70-77

41. Möhlenbruch MA, Kabbasch C, Kowoll A, Broussalis E, Sonnberger M, Müller M, et al. Multicenter experience with the new SOFIA Plus catheter as a primary local aspiration catheter for acute stroke thrombectomy. *J Neurointerv Surg* 2017;9:1223-1227

42. Wessell AP, Cannarsa G, Carvalho H, Kole MJ, Sharma P, Le EJ, et al. Thrombectomy for acute ischemic stroke with the new Sofia 6-French PLUS distal access reperfusion catheter: a single-cen-

ter experience. *Neuroradiol J* 2020;33:17-23

43. Li J, Tomasello A, Requena M, Canals P, Tiberi R, Galve I, et al. Trackability of distal access catheters: an in vitro quantitative evaluation of navigation strategies. [published online ahead of print Apr 21, 2022] *J Neurointerv Surg* 2022

44. O'Cearbhaill RM, Alderson J, Power S, Herlihy DB, Brennan P, O'Hare A, et al. Improving endovascular access to the target vessel for thrombus aspiration -use of the wedge device to overcome anatomic hurdles. *Interv Neuroradiol* 2022;28:213-218