Original research

Early experience with the Drivewire 24: a newly FDA-approved steerable microwire

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ABSTRACT

Background The Drivewire 24 (DW24) is a newly FDA-cleared 0.024 inch steerable guidewire. Its proximally controlled deflectable tip allows for intravascular steering to facilitate selective navigation of diagnostic or therapeutic catheters. We present the first clinical experience with the DW24.

Methods All neurointerventional procedures using the DW24 from October 2024 to April 2025 were retrospectively reviewed. Indications, procedural details, DW24 performance, wire-related complications, and operator feedback were assessed.

Results 27 procedures were performed utilizing the DW24. Indications included aneurysm (n=16), stroke (n=5), arteriovenous fistula or malformation (n=4), and diagnostic venography (n=2). Technical success was achieved in 92.6% of cases. Target vessels included the MCA, anterior cerebral artery, posterior cerebral artery, internal carotid artery segments, transverse sinus, and torcula. The device's radiopaque, hydrophilic distal tip aided fluoroscopic visibility, and the variable support enabled articulation across a range of aspiration and delivery catheters without requiring additional support devices. The DW24's steerability enabled access to challenging cerebrovascular anatomy, including one stroke case where conventional guidewires failed to reach a distal M2 occlusion. The DW24's intravascular steering also allowed for the delivery of catheters for Pipeline Embolization Device (PED) deployment and facilitated PED post-processing to improve wall apposition without requiring wire removal, reshaping, or balloon angioplasty. Operators observed a short learning curve. There were no device-related complications, though the wire's response to rotational force was a limitation.

Conclusion The DW24 demonstrated a high technical success rate with no device-related complications. Its versatility across catheter sizes and precise controllability facilitate navigating complex cerebrovasculature. Further studies should assess efficacy in larger cohorts across additional clinical scenarios.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The steerable 0.014 inch Columbus 'Drivewire' marked an advancement in neurointerventional devices, but its use is reported to be significantly limited by its fragile construction and poor response to rotational force. Thus, its production was stopped.

WHAT THIS STUDY ADDS

⇒ This study presents the first single-center clinical experience evaluating the newly cleared Drivewire 24 device, a steerable 0.024 inch guidewire, in 27 patients with a range of cerebrovascular pathology.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The Drivewire 24 was used successfully in 25 of 27 cases and shows significant promise in improving the safety and efficacy of neurointerventional procedures.

INTRODUCTION

Guidewires play a critical role in neurointervention, providing access to the intricate cerebral vasculature and allowing navigation of microcatheters to their target sites.[1] Since their initial development in the late-20th century, neuro guidewires have evolved substantially to improve the precision of various procedures, including thrombectomy, embolization, and flow diverter deployment.[2–4]

While different guidewires vary in their physical properties, such as their size, torque, and stiffness, traditional straight guidewires are limited in their ability to navigate complex vasculature.[5–7] Reshaping traditional guidewire tips into curved or looped shapes also must be performed manually outside of the patient, often requiring multiple adjustments. Manually shaped tips also commonly lose their form over time.[8]

For these reasons, the development of the steerable guidewire (Rapid Medical) marked a major advancement in neurointervention.[9] This 0.014 inch diameter guidewire was the first with the unique ability to be shaped inside the patient with its remotely controlled deflectable tip, allowing maneuvers impossible with traditional guidewires.[9–11] However, its more fragile 0.014 inch diameter was a notable limitation, restricting its response to rotational force and making it more susceptible to damage, which ultimately led to its removal from the market.[9]

The newly US Food and Drug Administration (FDA)-cleared steerable Drivewire 24 (DW24) has a more robust 0.024 inch diameter and is designed to improve on the limitations of the original

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Figure 1 The Drivewire 24 is a novel 0.024 inch steerable guidewire with a deflectable tip controlled via a proximal handle. This allows for in situ, real-time tip deflection.

Drivewire 14. We report the first clinical experience with the DW24, framing its potential applications within the field of neurointervention.

METHODS

Device details

The Drivewire 24 (DW24), produced by Rapid Medical Ltd (Yokneam, Israel), is a steerable guidewire with a nominal diameter of 0.024 inches. It is designed for use in the cerebral and peripheral vasculature. The DW24 has a deflectable tip that allows for in situ, real-time deflection to navigate a variety of angles and deflect micro and intermediate catheters in order to deliver the catheter without wire forerun (figure 1). Pulling the handle decreases the radius, curving the tip, whereas pushing the handle increases the curvature radius, straightening the tip. The DW24 handle automatically maintains its last position and locks the tip shape, thereby allowing the operator to control the degree of deflection.[9 11]

The Drivewire is intended for use with conventional microcatheters and intermediate catheters compatible with 0.024 inch wires. It has a total length of 204 cm, including a 100 cm length from the distal end to the fluorosafe marker, a 40 cm radiopaque length to aid fluoroscopic visibility, a distal tip length of 15.7 mm, and a 5 mm tip bend diameter when the DW24 is shaped into a loop (figure 2).

Based on benchmark studies performed by the company, the DW24 has a softer tip than the Aristotle 24 guidewire (Scientia Vascular) relative to other microwires currently on the market, making it more similar to the Synchro Support guidewires (Stryker).

Compared with the Columbus guidewire's 0.014 inch nominal diameter, the DW24's larger diameter offers greater support and stability. The larger diameter also enhances torque transmission, improving the guidewire's response to rotational movement.

Patient selection and clinical evaluation

Twenty-seven neurovascular procedures in 26 patients were performed from October 2024 through April 2025. Patient informed consent was obtained for all endovascular interventions. Our institution's institutional review board waived patient consent for this report due to the use of retrospective de-identified data (s22-0111).

Cases were retrospectively reviewed through the institution's electronic medical record. Patient demographics, lesion characteristics, procedural details and outcomes, and clinical and angiographic follow-up were evaluated. All clinical and technical adverse events were recorded, whether related to the DW24 or otherwise. While procedural outcomes were reviewed in detail, patient clinical outcomes, such as modified Rankin Scale (mRS) scores, were not recorded to the expectation that those outcomes are more dependent on the individual patient pathology and underlying disease course than the use of the device.

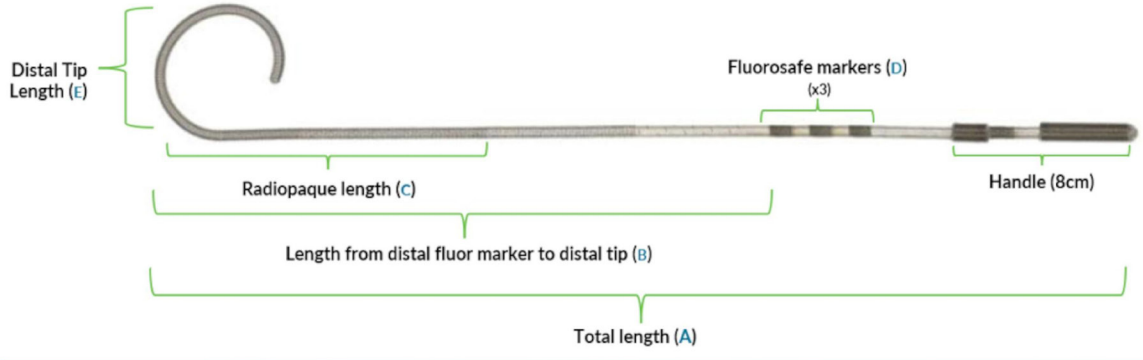
Procedure

The use of the DW24 was selected on an individual case-by-case basis, as determined by the interventionalists' preoperative planning and intraoperative considerations. Technical success was evaluated retrospectively and defined as the wire's ability to (1) successfully reach the target vessel segment and (2) support catheter navigation to the target area. The target vessel segments were defined before case analysis, rather than retrospectively. Operator feedback was retrospectively collected and assessed qualitatively.

RESULTS

Patient characteristics

The DW24 was used in 27 procedures treating 26 patients with a median age of 59.8 years (19.0–83.9 years), most of whom



DRIVEWIRE 24 | Catalog Number: DRPP2411 (Single) | Catalog Number: DW245P (5 Pack)

OD (in)	(A) Total length including handle (cm)	(B) Length from distal end to fluorosafe marker (cm)	(C) Radiopaque length (cm)	(D) Fluorosafe length (cm)	(E) Distal tip length (mm)	(F) Tip bend diameter Drive Loop shape (mm)	Tip bend diameter – J shape (mm)	Hydrophilic coating length (cm)	Microcatheter ID compatibility (in)
0.024	204	100	40	5	15.7	5	10	42	0.027"

Figure 2 Schematic of the Drivewire 24 and its components. ID, inner diameter; OD, outer diameter.

were female (n=18, 69.2%) and white (n=11, 42.3%) (table 1). Radial access was obtained in 13 cases, femoral access in 12, and both femoral and radial access in 2.

The indication for treatment was aneurysm treatment in n=15 cases (figure 3), dissecting pseudoaneurysm embolization in n=1, stroke thrombectomy in n=5, dural arteriovenous fistula (dAVF) embolization in n=2, arteriovenous malformation (AVM) embolization in n=2, and diagnostic angiography/venography with intracranial sinus manometry in n=2 (one for pseudotumor cerebri and one for possible sigmoid sinus thrombosis). Five primary operators were involved in this study.

Technical success and device failures

In all 27 cases, the DW24 reached its designated target vessel, and in 25/27 (92.6%), the catheter reached the targeted vessel segment, and its use was considered successful by the treating neurointerventionalist.

The DW24 served as the primary microwire in n=14 cases (51.9%). In two thrombectomy cases (7.4%), it was used as a secondary wire after other wires failed to cannulate the target vessels and reach the more distal occlusions. In these cases, the DW24 successfully navigated to the target vessel, enabling successful revascularization. In the remaining n=8 cases (29.6%), the DW24 was used successfully in combination with other microwires. Of the 13 flow diversion cases, Pipeline Embolization Device (PED) postprocessing was performed in five—in four using the DW24 and in one with balloon angioplasty. In one of the DW24 cases, the DW24 was used solely for postprocessing of a large multi-PED construct.

In the first case considered to be unsuccessful (case 18), a patient was undergoing attempted embolization of a right inferior frontal AVM. The DW24 was successfully navigated to the target A1 segment of the anterior cerebral artery with the goal of advancing a Socrates 038 catheter (Scientia Vascular, West Valley City, UT) into the vessel. However, the wire did not provide sufficient support to facilitate catheter advancement, and the operator expressed concern that advancing the microwire further distally towards the AVM nidus to achieve the necessary support would be unsafe due to the risk of vessel injury. Consequently, the operator decided to replace the DW24 with an Aristotle 18 Guidewire (Scientia Vascular), and the intermediate catheter was successfully navigated to the desired position. The AVM was embolized with n-BCA (n-butyl cyanoacrylate) glue.

Notably, this patient underwent a second embolization of this AVM 2 months later to reduce its size further. In this procedure (case 25), the DW24 was successfully used to navigate the catheter into the contralateral A1 segment and supported the advancement of a Socrates 038 catheter without complication.

In the second case considered to be unsuccessful (case 23), a patient was undergoing attempted flow disruption of a ruptured 13 mm middle cerebral artery (MCA) bifurcation aneurysm. The DW24 was successfully advanced to the MCA bifurcation, but it did not torque sufficiently to navigate into the aneurysm's dome. For this reason, the operator elected to use an Aristotle 18 (Scientia Vascular) instead, and the Woven EndoBridge single-layer (WEB SL) device was successfully placed. No device malfunctions or failures occurred in any other procedures.

One case (case 7, embolization of a dAVF at the right transverse sigmoid junction) was complicated by a late postoperative right-sided subdural hematoma (SDH) with midline shift due to vessel perforation by a different wire. This required emergent transfer to the operating room for evacuation and decompression. This complication was unrelated to the DW24, as the SDH occurred on the right side, whereas the DW24 was used on the patient's left. No other intraoperative complications occurred.

Patient outcomes

Clinical follow-up was available at a median of 35 days (1–100 days) post-intervention. Two patients died, both from medical conditions unrelated to their cerebrovascular pathology, and one patient suffered a stroke 10 days postoperatively for reasons unrelated to the device. All other patients were doing well at their most recent clinical follow-up with no complications.

Notably, all patients treated for aneurysm or pseudoaneurysm showed good device positioning and contrast stasis within the aneurysm's sac, and all patients with arteriovenous fistulae or malformations showed reduced or absent flow into the malformation.

Subjective evaluation and recommendations

The DW24 is an effective device with excellent ability to navigate tortuous distal vasculature. It has a well-balanced combination of flexibility and support that allows for precise control in challenging anatomy while still supporting a broad range of catheters. The ability to shape the distal tip in situ allows one to navigate the delivery catheter and then reshape the tip for device post-processing, a versatility impossible with other current microwires. However, while the DW24 offers improved torquability over its predecessor, its response to rotational force remains suboptimal. Further refinements in shaft design and torque response would improve its overall performance, particularly when in its tightly curved tip shape and when navigating especially tortuous segments.

The wire's 'handle' is another current limitation. In its current design, the wire's proximal control handle can be slightly challenging or awkward to use at times, limiting the ability to dynamically reshape the wire tip while simultaneously navigating. To address this, efforts by the company to design an improved and more ergonomic handle are underway.

DISCUSSION

Advantages of the DW24

This is the first study reporting early clinical experience with the new Drivewire 24. Overall, the device demonstrated a high degree of effectiveness across a range of procedures, achieving technical success in all but two cases. A significant advantage of the DW24 was its superior navigational versatility compared with non-steerable wires, offering real-time in situ deflection to accommodate varying vascular curvatures and reduce vessel wall contact.[12 13] Shaping the tip into a curve can also help anchor the wire within a vessel, providing support for catheter advancement.[9 11]

Thrombectomy

The DW24 was used in five thrombectomies, and in all cases the wire was successful in navigating to the level of the occlusion. This was particularly notable in case 3, in which other guidewires were initially unsuccessful in reaching the occlusion within the V4 segment of the vertebral artery. However, once the DW24 was used, the ability to adjust the tip in situ allowed for quick canalization of the target vessel. A RED 62 aspiration catheter (Penumbra, Alameda, CA) was then successfully navigated to the clot, and revascularization was achieved. This was also seen in case 9, in which the DW24 was able to navigate a particularly sharp turn in the posterior cerebral artery (PCA), successfully reaching an occlusion at the right P2/P3 junction

Table 1 Neurointerventional procedures performed with the Drivewire 24

Case	Pathology	Intervention	Vessel navigated by DW24 (target vessel reached?)	Catheters used with DW24	Deployed device, embolic agent, or suction catheter	Immediate operative outcome by DSA	Intraoperative complications	Comments
1	Aneurysm, 7 mm PICA	Intrasaccular device and flow diversion	V4 of vertebral artery (Yes)	VIA 27, Phenom 27	WEB SL, PED	Intra-aneurysmal flow stasis	None	–
2	Aneurysm, 11.5 mm anterior choroidal	Intrasaccular device and flow diversion	M2 of MCA (Yes)	VIA 33, Phenom 27	WEB SL, PEDx2	Intra-aneurysmal flow stasis	None	–
3	Stroke, right V4 and left P2 occlusions	Thrombectomy	V4 (Yes)	Socrates 38, RED 62	RED 62	TICI 2B of V4	None	Glidewire initially failed to navigate to the distal clot, DW24 successful as the secondary wire
4	Stroke, left distal M2 occlusion	Thrombectomy	M2 of MCA (Yes)	SOFIA 5	SOFIA 5	TICI 3	None	Multiple failed revascularization attempts until the DW24 was used as the secondary wire
5	Aneurysm, 4 mm paraophthalmic	Flow diversion	M2 of MCA (Yes)	Phenom 27	PEDx2	Intra-aneurysmal flow stasis	None	PED postprocessing with HyperGlide balloon
6	dAVF, falcotentorial	Embolization	MMA (Yes)	Socrates 038	n-BCA	Complete dAVF occlusion	None	–
7*	dAVF, transverse sigmoid sinus	Embolization	Transverse sinus (Yes)	Phenom PLUS	PEDx2	Reduced flow into the dAVF	SDH requiring OR evacuation, unrelated to DW24	–
8	Aneurysm (mycotic), 7 mm M4	Embolization	M1 of MCA (Yes)	Socrates 038	n-BCA	Intra-aneurysmal flow stasis	None	–
9	Stroke, bilateral P2/P3 junction occlusions	Thrombectomy	P2/P3 junction of PCA (Yes)	Socrates 038	Socrates 38	TICI 3 bilaterally	None	–
10	Aneurysm, 11 mm MCA bifurcation	Intrasaccular device	M1 of MCA (Yes)	VIA 33, SOFIA 5	WEB SL	Intra-aneurysmal flow stasis	None	–
11	Bilateral transverse sinus stenoses	Diagnostic venogram	Torcula (Yes)	Midway 43	n/a	Successful diagnostic venography	None	–
12	Aneurysm, 6 mm pericallosal ACA	Flow diversion	Cervical ICA (Yes)	Simmons 2 diagnostic catheter	PED	Intra-aneurysmal flow stasis	None	–
13	Aneurysm, 3 mm paraophthalmic	Flow diversion	Paraophthalmic ICA (Yes)	Phenom 27, Phenom PLUS	PED	Intra-aneurysmal flow stasis	None	DW24 also used for PED postprocessing
14	Aneurysm, 3.8 mm M1	Flow diversion	M1 of MCA (Yes)	Phenom 27, SOFIA 5	PED	Intra-aneurysmal flow stasis	None	–
15	Aneurysm, 4 mm PCom	Flow diversion	Paraophthalmic ICA (Yes)	Phenom 27, Phenom PLUS	PEDx2	Intra-aneurysmal flow stasis	None	–
16	Stroke, right distal M2 occlusion	Thrombectomy	M1 and M2 of MCA (Yes)	Socrates 038, SOFIA PLUS	SOFIA PLUS	TICI 2c	None	–
17†	Pseudoaneurysm (dissecting), cervical ICA	Flow diversion	Cervical ICA (Yes)	n/a	PEDx9	Intra-aneurysmal flow stasis	None	DW24 used only for PED postprocessing
18	AVM, right inferior frontal	Embolization	A1 of ACA (Yes, though it did not support catheter advancement)	n/a	n-BCA	Significantly reduced flow into the AVM	DW24 provided insufficient catheter support without further distal advancement	DW24 exchanged for Aristotle 18, embolization achieved
19	Aneurysm, 6 mm M1	Flow diversion	M1 of MCA (Yes)	Phenom 27, Phenom PLUS	PED	Intra-aneurysmal flow stasis	None	–
20	Aneurysm, PCom (small residual neck)	Flow diversion	Paraophthalmic ICA (Yes)	Navien 058	PED	Intra-aneurysmal flow stasis	None	–
21	Aneurysm, 5.3 mm M1	Flow diversion	M1 of MCA (Yes)	Phenom 27, Phenom PLUS	PED	Intra-aneurysmal flow stasis	None	–
22	Aneurysm, 3.3 mm superior hypophyseal	Flow diversion	Paraophthalmic ICA (Yes)	Phenom 27, Phenom PLUS	PED	Intra-aneurysmal flow stasis	None	DW24 also used for PED postprocessing
23	Aneurysm, 13 mm MCA bifurcation	Intrasaccular device	M1 of MCA (Yes, though it could not navigate into the aneurysm's dome)	VIA 27	WEB SL	Intra-aneurysmal flow stasis	DW24 did not torque sufficiently to enter the aneurysm's dome	DW24 exchanged for Aristotle 18, flow disruption achieved
24	Aneurysm, 6.5 mm PCom (residual neck)	Flow diversion	Paraophthalmic ICA (Yes)	Phenom 27, Navien 058	PED	Intra-aneurysmal flow stasis	None	DW24 also used for PED postprocessing
25	AVM, right inferior frontal	Embolization	A1 of ACA (Yes)	Socrates 38	n-BCA	Significantly reduced flow into the AVM	None	–
26	Stroke, mid-basilar and left P3 occlusions	Thrombectomy	P3 of PCA (Yes)	Socrates 38	Socrates 38	TICI 3	None	–

Continued

Table 1 Continued

Case	Pathology	Intervention	Vessel navigated by DW24 (target vessel reached?)	Catheters used with DW24	Deployed device, embolic agent, or suction catheter	Immediate operative outcome by DSA	Intraoperative complications	Comments
27	Transverse/sigmoid sinus junction stenosis	Diagnostic venogram	Torcula (Yes)	Socrates 38	n/a	Successful diagnostic venography	None	–

*In this case, a Phenom 27 within a Phenom PLUS was navigated into the transverse sinus over the DW24 and used to deploy two Pipeline Vantage Embolization Devices (Medtronic) (6×40 mm, 6×20 mm). Onyx liquid embolic (Medtronic) was then delivered through a jailed microcatheter between the PEDs and the inner wall of the sinus at the level of the fistulization until achieving complete obliteration while preserving flow in the sinus.
†While this was a flow diversion case, the DW24 was used only for postprocessing of the multi-PED construct to ensure complete device expansion and good apposition to the vessel wall.
ACA, anterior cerebral artery ; AVM, arteriovenous malformation; dAVF, dural arteriovenous fistula; DSA, digital subtraction angiography; DW24, Drivewire 24; ICA, internal carotid artery; MCA, middle cerebral artery; MMA, middle meningeal artery; n-BCA, n-butyl cyanoacrylate; OR, operating room; PCA, posterior cerebral artery ; PCom, posterior communicating artery; PED, Pipeline Embolization Device; PICA, posterior inferior cerebellar artery; SDH, subdural hematoma; TICI, Thrombolysis In Cerebral Infarction; WEB SL, Woven EndoBridge single-layer.

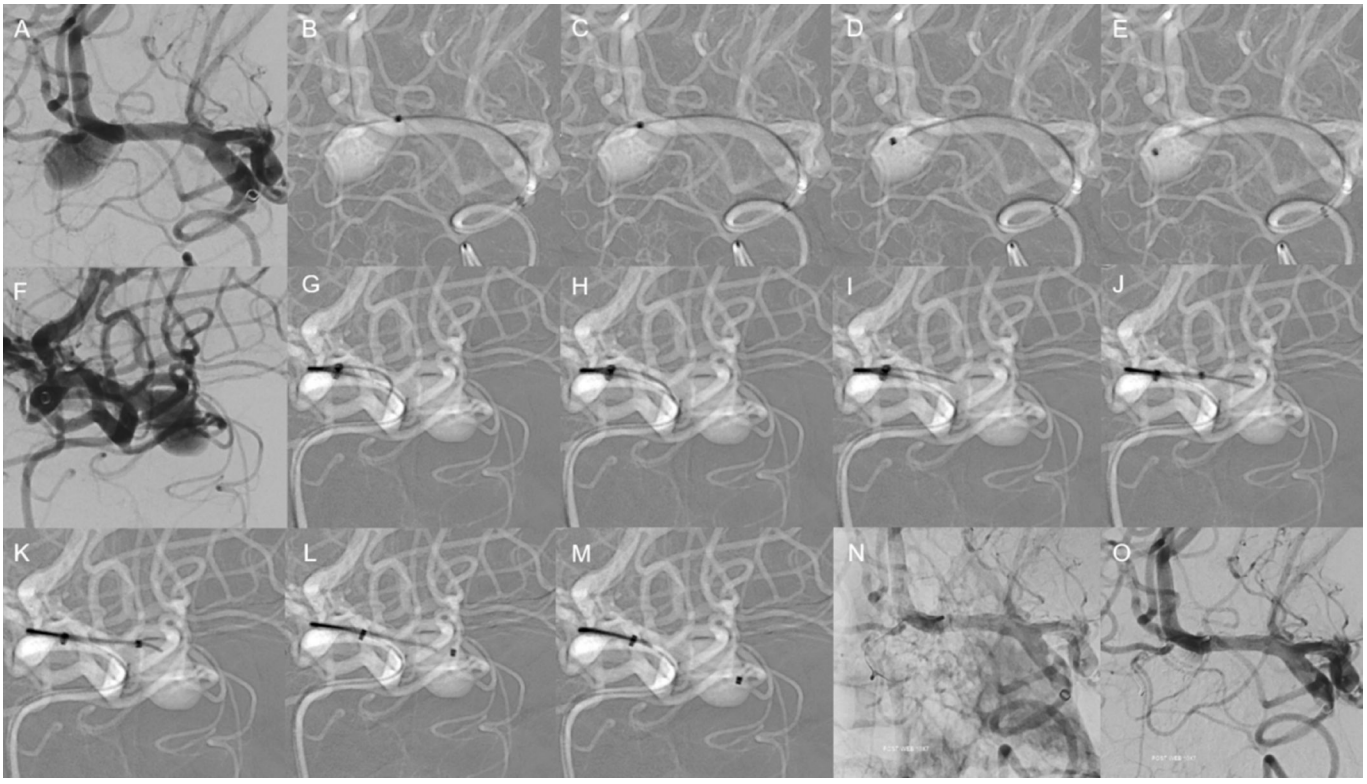


Figure 3 Illustrative case. Case 10. The patient underwent treatment for an 11×8 mm MCA bifurcation aneurysm with a 3.5 mm neck, as seen in (A) lateral and (F) frontal views. The Drivewire 24 was navigated to the level of the right MCA. The DW24's tip was then gently deflected while entering the aneurysm to avoid contact with the aneurysm's wall, as seen in both (B–E) lateral and (G–M) frontal views. Once inside the dome, a Via 33 was navigated over the DW24 and slowly advanced into the aneurysmal sac. A single WEB SL device, measuring 10×7 mm, was delivered into the aneurysmal sac. After WEB deployment, DSA demonstrated good filling of the aneurysmal sac with contrast stagnation and good filling of the MCA M2 divisions without evidence of thromboembolism, dissection, or other complication, as seen from (N) lateral and (O) frontal views. DSA, digital subtraction angiography; MCA, middle cerebral artery; WEB SL, Woven EndoBridge single-layer.

without advancing the wire into distal PCA segments for wire forerun. While outcomes, such as Thrombolysis In Cerebral Infarction (TICI) scores, were reported for each procedure, it should be clarified that the DW24 was only evaluated in terms of improved technical success (ie, wire and catheter navigation) and not procedural outcome.

A major advantage of the DW24 relative to traditional guidewires is the ability to curve the wire tip to avoid entering small perforating branches, allowing the wire to track along the largest vessel branch and navigate to the occlusion.[9 11] While this can also be achieved by removing the wire and reshaping it to a J-shape, such a maneuver adds time to the procedure and forces the operator to lose the position of the microwire.

Aneurysm treatment

The most common indication for use of the DW24 was for aneurysm treatment, and the wire was successful in navigating a range of microcatheters and intermediate catheters through the intracranial vasculature to perform a variety of procedures. The wire provided sufficient support for catheters, allowing deployment of PEDs or WEB devices. The DW24's deflectable tip is particularly advantageous in aneurysm treatment due to the ability to enter the aneurysm's dome while carefully curling the tip to avoid contact with the fragile aneurysmal wall. This decreases the risk of iatrogenic rupture while simultaneously allowing for targeted delivery into aneurysmal sacs or across aneurysmal necks for flow diverter use.[14–17]

PED post-processing

Besides aiding navigation of catheters for flow diversion, the DW24 can additionally be used for PED post-processing, as was seen in four cases. Instead of exchanging the guidewire for a different wire and reshaping to a J-configuration, the DW24 tip can be remotely curved into a loop in situ to ensure complete device expansion and good wall apposition.[18 19]

Limitations of the DW24

One of the two DW24 failures involved insufficient torquability while attempting to navigate into the dome of an MCA bifurcation aneurysm. While the DW24 improves on the original 0.014 inch Drivewire in this regard, operators consistently cited limited rotational responsiveness as a limitation. Overcoming vascular tortuosity requires substantial wire torque, especially across multiple curves where rotational force transmission is reduced.[20 21] The DW24's stiff core and flexible tip—important features for catheter support and navigation of tortuous vasculature, respectively—may further compromise torquability.

The second failure noted in this study occurred during an attempted AVM embolization. While the DW24 successfully reached the target A1 segment, its distal segment lacked the strength to support the advancement of the Socrates 038 without further distal wire advancement, which was deemed unsafe by the operator. As mentioned previously, the wire's proximal control handle is also a current limitation, as it can be ergonomically difficult to reshape the wire tip while simultaneously navigating. The company is currently working to design an improved handle to address this challenge.

Study limitations

This study is primarily limited by its retrospective design and relatively small sample size, which may affect the generalizability of the findings. Prospective studies are needed to better assess efficacy in larger cohorts across broader clinical scenarios. Additionally, the impact of the operators' learning curve was not formally or quantitatively assessed. Although operators reported a qualitatively brief learning curve, the number of cases required to achieve procedural efficiency remains undefined. Moreover, potential differences in outcomes between individual operators were not evaluated and may represent an additional source of variability.

CONCLUSION

The Drivewire 24 marks an advancement in neurointerventional devices. Its real-time steerability allows for smooth navigation through tortuous and complex cerebrovasculature. It demonstrated a high technical success rate with no device-related malfunctions, breakages, or device-related complications. Its versatility across catheter sizes supports its use for a variety of neurointerventional procedures, including thrombectomy, flow diversion, intrasaccular device deployment, and intermediate catheter navigation. Further studies are needed to assess its torquability and efficacy in larger cohorts across additional clinical scenarios.

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Competing interests EN is a consultant for Rapid Medical and Longeviti, serves on the medical board of Longeviti, and holds stock equity or options in Rapid Medical and Longeviti. ER receives grant funding from Balt, Imperative Care, Medtronic, Vasorum, Q'Apel, Siemens, Microvention, and Phenox. MS is a consultant for Medtronic. The other authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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