ENGLISH
INSTRUCTIONS FOR USE
PulseRider® Aneurysm Neck Reconstruction Device

Humanitarian Device. Authorized by Federal law for use with neurovascular embolic coils in patients ≥ 18 years of age for the treatment of unruptured wide-necked intracranial aneurysms with neck widths ≥ 4 mm or a dome to neck ratio < 2 originating on or near a vessel bifurcation of the basilar tip or carotid terminus with at least a portion of the aneurysm neck overlapping the lumen of the parent artery. The inflow vessels should have diameters from 2.7 mm to 4.5 mm. The effectiveness of this device for this use has not been demonstrated.

Device Description

The PulseRider® is a self-expanding nitinol implant designed to retain embolic coils at or near a vessel bifurcation as specified in the Indications for Use. PulseRider® is comprised of the torque device, delivery wire, introducer, and implant.

Figure 1: PulseRider® Device (not to scale)

The implant is provided attached to the delivery wire. The delivery wire has a working length of 190 cm and a nominal diameter of 0.36 mm (0.014"). The introducer has a working length of 67 cm and a nominal diameter of 1.32 mm (0.052"). The PulseRider system is intended to be used with commercially available detachment power supplies (not shown) and microcatheters (not shown) with minimum inner diameter of 0.53 mm (0.021"). The implant and delivery wire are insulated to allow the electrolytic current to be delivered to the detachment junctions. The distal 20" (51 cm) of the delivery wire is hydrophilically coated and should remain inside the introducer sheath whenever it is not inside the delivery catheter. The torque device provided may be attached to the proximal end of the delivery wire to aid in orienting the implant prior to detachment. All of the PulseRider® components are packaged in a sealed pouch and are provided sterile. Sterilization is by ethylene oxide gas exposure.

PulseRider® is available in T and Y shapes with 8 mm and 10 mm wide arches. The anchor base is available in sizes to treat parent arteries from 2.7 mm to 4.5 mm. Depending on the size of the aneurysm neck and parent vessel, the appropriate size PulseRider® implant must be chosen to ensure adequate stability and anatomical fit.

Note: The optimal treatment for unruptured cerebral aneurysm is not specific due to a large number of variables and concern related to subarachnoid hemorrhage (SAH), a life-threatening event. To ensure that the probable benefits outweigh the risk of treatment, in addition to the size of the aneurysm, other risk factors should be considered, e.g., morphology, hemodynamic characteristics, patient age, family history, prior SAH, and general medical history.

Implant Size and Shape Selection

PulseRider diameter selection: The PulseRider comes in two anchor sizes labeled with the intended parent vessel (below the branches) diameters. 2.7 mm – 3.5 mm and 3.5 mm – 4.5 mm. The parent vessel diameter should be measured approximately 1 cm below the aneurysm neck. Select a PulseRider implant where the parent vessel diameter falls within the diameter limits listed on the label. No additional oversizing is needed nor recommended.

Arch width and shape selection: The selection of the appropriate shape (T or Y) and arch width (8 mm or 10 mm) is made by assessing the width, location, and orientation of the aneurysm neck and the branch artery angles relative to the parent vessel.

The largest width arch that will fit the neck generally provides the best coverage of the aneurysm neck. This coverage must be balanced against the anatomical fit to the particular anatomy of the bifurcation. The arch will reach to approximately half the labeled width from the parent vessel centerline along each branch vessel. Use this value (4 mm for 8 mm wide arches, and 5 mm for 10 mm wide arches) to determine the extent of the arch coverage relative to the neck along each branch. Select the PulseRider width that provides the desired amount of coverage relative to the limits of the aneurysm neck. Note: Full coverage of the neck is optimal, but not at the compromise of anatomical wall apposition. In some cases, the PulseRider will cover a portion of the neck, reducing but not eliminating it while allowing the aneurysm to be coiled successfully.

Arch conformation & flexibility: Each wing of the PulseRider arch can flex independently of the other. This provides overall conformability of the implant in the proximal and out-of-plane directions to conform to branch vessels with relative angles below the natural angle of the arch and when they are not oriented 180° apart in the working plane. The arches can also flex in the distal direction when placed within the aneurysm sac in either the partial or fully intra-aneurysmal position.

Y-shape: The Y shape implants will fit best where the intended implantation location includes at least one branch artery angled between 90° and 120° relative to the axis parent artery. This angle must be assessed at the intended arch width of the PulseRider selected to ensure that the arch will conform to the wall of the branch artery without crossing the lumen. The angles of the branch arteries do not have to be the same angle or align with the working projection plane.

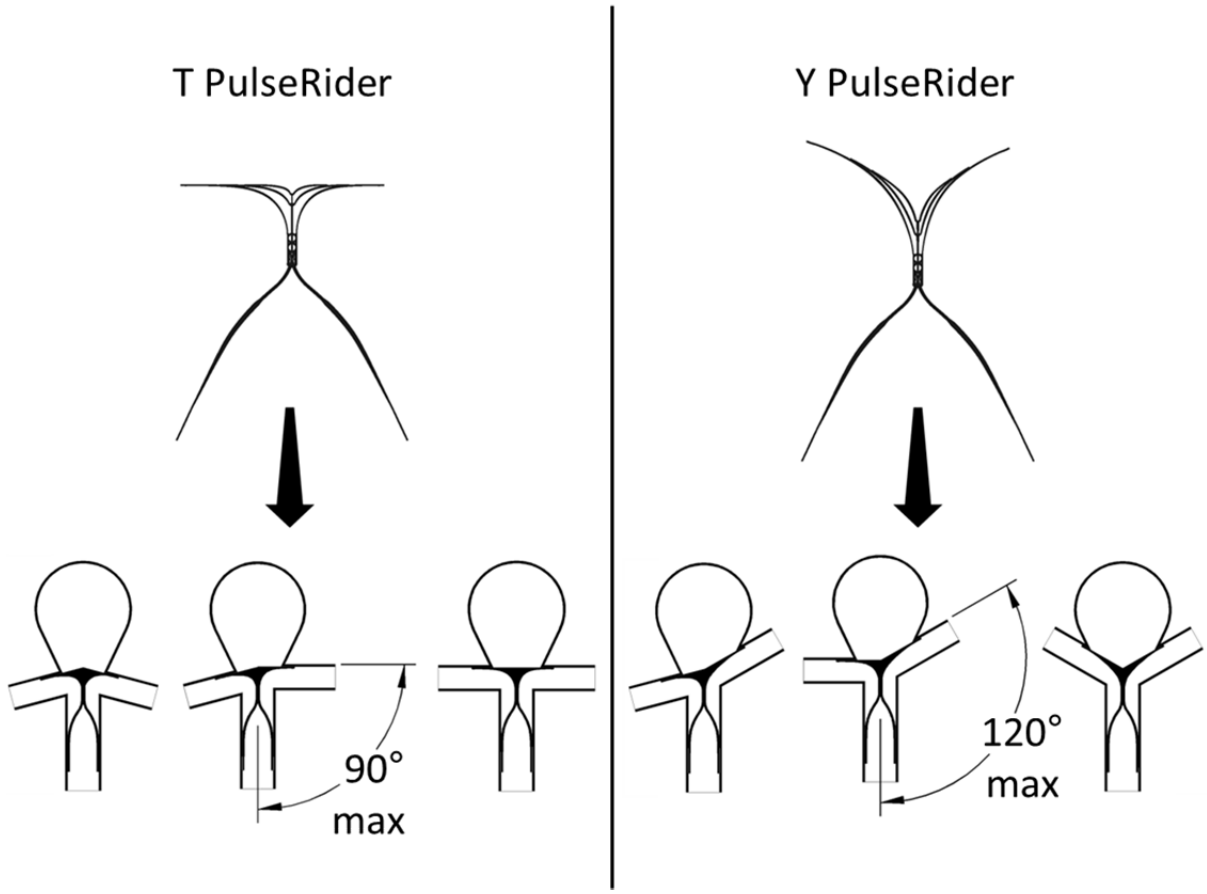
T-shape: The T shape implant will fit best where both of the branch artery angles are 90° or less relative to the axis of the parent vessel artery. This angle must be assessed at the intended arch width of the PulseRider selected to ensure that the arch will conform to the wall of the branch artery without crossing the lumen. The angles of the branch arteries do not have to be the same angle or align with the working projection plane.

Partial & fully intraaneurysmal: Either shape device may be placed partially or fully intraaneurysmally as needed to best position the arch section across the aneurysm neck. These options should be considered when the branches are partially or fully incorporated into the aneurysmal sac such that the arch tips cannot successfully engage one or both branches. This position can also help place the PulseRider across the neck to support embolization coils in cases where the branch angles and alignment in the working projection and/or the out-of-plane direction exceed the ability of the arch to conform acceptably to the artery lumen as confirmed on fluoroscopic imaging.

Carefully examine the fit of the PulseRider implant in both the working projection and lateral to the working projection prior to initiating coiling to ensure the arch is placed in the desired location relative to the aneurysm neck and the extraaneurysmal portions of the arch are conforming to the walls of the branch arteries without crossing the lumen. See Figures 2 through 4 below.

Figure 2

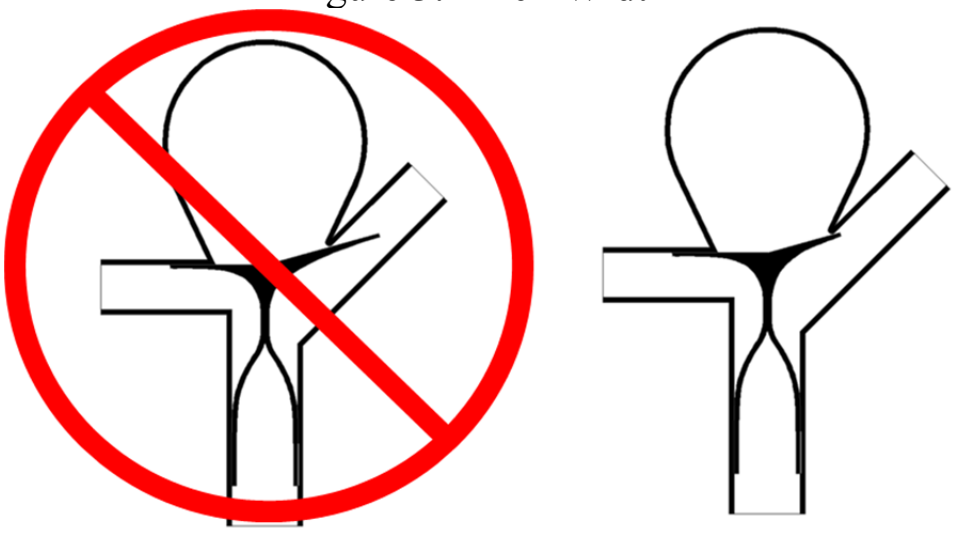
PulseRider Shape Selection



Typical examples of anatomical variations appropriate for “T” shape PulseRider

Typical examples of anatomical variations appropriate for “Y” shape PulseRider

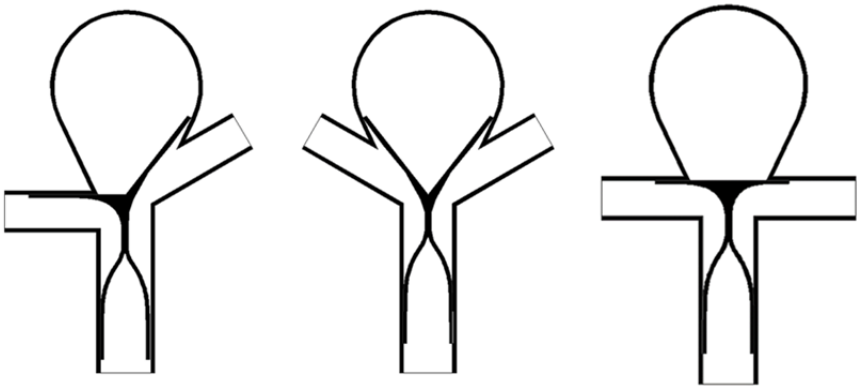
Figure 3: Arch Width



PulseRider arch encroaching on branch artery – arch oversized

Narrower arch width may improve implant fit

Branches Angulated in Working Projection / In-Plane



Partially Intraaneurysmal

Intraaneurysmal

Extraaneurysmal

Branches Angulated in Lateral Projection / Out-of-Plane

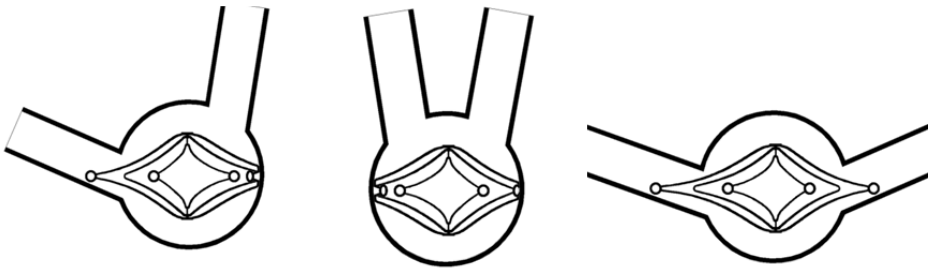
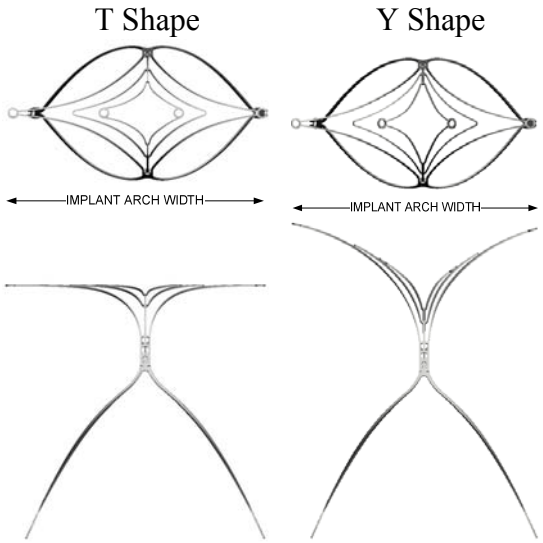


Figure 4: Implant Positioning Examples

Table 1: Sizing Guidelines

	Device Catalog Number	Target Aneurysm Neck Width (mm)	Parent Vessel Diameter (mm)	Implant Arch Width (mm)
 T Shape Implant	**201-D**	8	2.7 - 3.5	8.6
	203-D	8	3.5 - 4.5	8.6
	211-D	10	2.7 - 3.5	10.6
	213-D	10	3.5 - 4.5	10.6
 Y Shape Implant	**301-D**	8	2.7 - 3.5	8.6
	303-D	8	3.5 - 4.5	8.6
	311-D	10	2.7 - 3.5	10.6
	313-D	10	3.5 - 4.5	10.6

There are three defining attributes of the implant: shape, arch width, and parent vessel diameter.



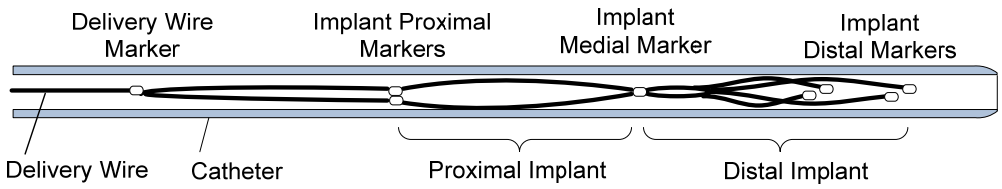


Figure 4: Constrained Implant Inside Microcatheter

Materials of Construction

Component	Implant	Delivery Wire
Base Material	Nitinol	Stainless Steel
Radiopaque Markers	Platinum/Iridium alloy	Platinum/Iridium alloy
Solder	Gold-Tin alloy	Gold-Tin alloy
Detachment Zone	Stainless Steel	Stainless Steel
Coatings, Outer Materials	Parylene	Parylene, Polyester Heatshrink, Hydrophilic Coating

Indications For Use

PulseRider® is indicated for use with neurovascular embolic coils in patients ≥ 18 years of age for the treatment of unruptured wide-necked intracranial aneurysms with neck widths ≥ 4 mm or dome to neck ratio < 2 originating on or near a vessel bifurcation of the basilar tip or carotid terminus with at least a portion of the aneurysm neck overlapping the lumen of the parent artery. The inflow vessels should have diameters from 2.7 mm to 4.5 mm.

Contraindications

PulseRider® is NOT indicated for:

1) Patients with vascular anatomy or dimensions at the targeted treatment site for which the available PulseRider® sizes are not appropriate (refer to package label for sizing information – **Table 1**).
2) Patients with severe vascular tortuosity or anatomy that would preclude the safe introduction of the PulseRider® device or the use of other devices involved with the procedure.
3) Patients with preoperative coagulation disorder, or with contraindications to antiplatelet or anticoagulant therapy.
4) Patients with known hypersensitivity to nickel.

Warnings

1) PulseRider® should only be used by physicians who have received appropriate training in interventional neuroradiology and treatment of intracranial aneurysms.
2) There may be an increased rate of serious adverse events associated with the partially intraaneurysmal and fully intraaneurysmal positioning of the PulseRider device.
3) Use caution when manipulating multiple catheters that are contained within the same guide catheter so as to avoid unintentional movement of catheters during the procedure.
4) When using a dual-catheter technique through a single guide catheter, ensure that no more than one catheter is placed through a single touhy seal. The touhy seals should be used to stabilize each catheter individually to prevent unintended movement of catheters that could destabilize the embolization coils, PulseRider implant or cause other patient injury.
5) Do not torque or rotate the delivery wire unless the implant distal markers are constrained within the microcatheter (**Figure 5**).
6) Do not advance or retract the implant after embolization coils have been detached in the aneurysm.
7) Do not torque or rotate the delivery wire more than 5 revolutions without observing a response at the distal end. Torqueing the device with the implant deployed and engaged in the vasculature may result in fracture of the device which could make removal difficult or impossible and may cause vessel damage or dissection. If the desired torque response is not obtained at the distal end after applying 5 proximal revolutions, remove the device from the patient, inspect for damage, and replace device if damage is evident or suspected.
8) Do not fully deploy and retrieve the implant more than 3 times. Excessive deployment cycles of the anchor section of the PulseRider may reduce the radial force of the device, which could impact the implant stability.
9) Never advance or apply torque against resistance without careful fluoroscopic assessment of the cause. Movement against resistance may result in damage to the vessel or the device. If the cause cannot be determined, withdraw the device from the patient and replace with a new device.
10) The distal diameter of the microcatheter used to introduce embolic coils into the aneurysm after placement of the PulseRider must not exceed 2.0 F (0.66 mm).
11) During deployment, the proximal implant length will foreshorten up to approximately 2.5 mm and the distal implant will expand from its constrained diameter to the labeled width of the arch section.
12) The best neck coverage and coil retention is provided when the distal tips of the arch section overlap the neck of the aneurysm. In all cases, observe carefully while coiling to ensure the coils do not herniate or prolapse through the open areas of the aneurysm neck or implant arch.
13) Increased detachment time may occur when the delivery wire and microcatheter markers are not properly positioned, there is improper setup of continuous flush, embolic coils are present, or connections between detachment power supply and delivery wire or patient's groin (return electrode) are poor.
14) If the patient experiences pain at the site of the return electrode, or if detachment time is excessive, replace the return electrode with a new needle and insertion site.
15) The implant is not resheathable after detachment from delivery wire. Ensure appropriate implant position before detachment from delivery wire.
16) Do not advance the delivery wire after detachment.
17) The MRI safety of the delivery system has not been assessed. Do not implant this device during an interventional MRI procedure in or near an MRI scanner.

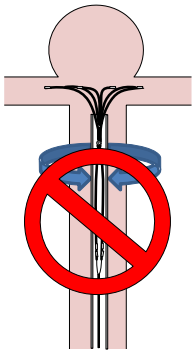


Fig. 5: Torque Not OK

Precautions

1) Store in cool, dry, dark place.
2) Do not use open or damaged packages.
3) Do not use devices that are past the "Use By" date.
4) Carefully inspect the package, implant, and delivery wire to ensure they are not damaged. Do not use the device if the sterile barrier is compromised or the device is damaged.
5) Do not expose to solvents.
6) For single use only. Do not reuse, reprocess, or resterilize because it may cause damage to the device or may result in patient injury, illness, or death.
7) This device contains nickel and may not be appropriate for patients with known hypersensitivity to nickel.
8) Use caution when crossing the deployed implant with adjunctive devices, including microcatheters and guide wires.

Potential Complications

Possible complications include, but are not limited to, the following:

1) Adverse tissue reaction
2) Allergic reaction and anaphylaxis from contrast media
3) Allergy to Nickel
4) Aneurysm perforation or rupture
5) Incomplete aneurysm occlusion and/or recanalization
6) Arteriovenous fistula
7) Coagulopathy
8) Device misplacement or migration
9) Coil migration, herniation or prolapsed into normal vessels through or around device
10) Emboli (air, tissue, thrombotic, device-related)
11) Access site complications such as hemorrhage, hematoma, pain, or infection
12) Intracranial or intracerebral hemorrhage
13) Neurological sequelae including but not limited to, ischemia, hemorrhage, embolic stroke, cranial nerve deficit, and death
14) Visual disorders (diplopia, blurred vision)
15) Deep Vein Thrombosis (DVT)
16) Hypoesthesia
17) Fever
18) Hypothermia
19) Vessel occlusion
20) Cranial nerve palsy / disorder
21) Stenosis or occlusion of treated vessel segment or device occlusion
22) Pseudoaneurysm formation
23) Vascular sequelae including vasospasm, thrombosis, dissection, perforation, or other trauma
24) Hydrocephalus
25) Increase in Intracranial Pressure (ICP)
26) Cognitive Impairment
27) Coma
28) Infarction
29) Phlebitis
30) Infection including UTI
31) Myocardial infarction
32) Cardiac arrhythmia
33) Temporary cortical blindness
34) Nausea and/or vomiting
35) Headache
36) Pneumonia
37) Ecchymosis
38) Dizziness
39) Death

MRI Safety Information

MR Conditional

Non-clinical testing demonstrated that the PulseRider implant is MR Conditional. A patient with an implant can be scanned safely in an MR system under the following conditions:

- Static magnetic field of 1.5-Tesla and 3-Tesla
- Maximum spatial gradient magnetic field of 3,000-gauss/cm (30-T/m)
- Maximum MR system reported, whole body averaged specific absorption rate (SAR) of 4-W/kg and maximum head SAR of 3.2 W/kg.

Under the scan conditions defined, the PulseRider implant is expected to produce a maximum temperature rise of 3.2˚C after 15 minutes of continuous scanning (i.e., per pulse sequence).

In non-clinical testing, the image artifact caused by the PulseRider implant extends approximately 5 mm from this implant when imaged using a gradient echo pulse sequence and a 3-Tesla MR system.

The MRI safety of the delivery system has not been assessed. Do not implant this device during an interventional MRI procedure in or near an MRI scanner.

Please consult the MRI labeling for all accessory devices including the implanted embolization coils to determine the MRI safety status of the embolization coils and other accessory devices.

Observed Adverse Events

During the Adjunctive Neurovascular Support for Wide-Neck-Aneurysm Embolization and Reconstruction (ANSWER) Clinical Study, the data on 34 patients (N) through 180 day (+/-45 days) follow-up included the following observed adverse events:

Adverse Event	Time of Occurrence			Total (n)	Frequency % (n/N*100%)
	Procedure	≤30 Days	>30 Days		
Allergy to Protonix	0	1	0	1	2.9%
Anemia, drop in hemoglobin	0	1	2	3	8.8%
Cauda equina syndrome	0	0	1	1	2.9%
Cerebral hematoma	0	0	1	1	2.9%
Coil perforation of aneurysm	1	0	0	1	2.9%
Confusion	0	1	0	1	2.9%
Constipation	0	1	1	2	5.9%
Death	0	0	1	1	2.9%
Deep vein thrombosis	0	1	0	1	2.9%
Depression – mild	0	1	1	2	5.9%
Dizziness	0	1	0	1	2.9%
Dysarthria	0	0	1	1	2.9%
Dysphagia	0	0	1	1	2.9%
Ecchymosis	0	2	0	2	5.9%
Emboli/Thrombus	1	0	0	1	2.9%
Fatigue, lower leg	0	1	0	1	2.9%
Femoral occlusion	0	1	0	1	2.9%
Fractured leg	0	0	1	1	2.9%
Gastroenteritis - viral	0	0	1	1	2.9%
Gastrointestinal bleed	0	0	1	1	2.9%
Gingivobuccal sulcus with mucosal injury	0	0	1	1	2.9%
Headache	0	9	1	10	29.4%
Hematoma, hemorrhage at access site	1	1	0	2	5.9%
Hematuria	0	1	0	1	2.9%
Hyperglycemia	0	0	1	1	2.9%
Hypotension	1	1	1	3	8.8%
Itching	0	1	0	1	2.9%
Leukocytosis	0	0	1	1	2.9%
Lumbago	0	0	1	1	2.9%
Migraine headaches	0	0	1	1	2.9%
Nausea and/or vomiting	0	3	1	4	11.8%
Night sweats	0	0	1	1	2.9%
Numbness left leg	0	1	0	1	2.9%
Nose bleed	0	1	0	1	2.9%
Otitis	0	0	1	1	2.9%
Oozing at site	0	1	0	1	2.9%
Pain	0	0	1	1	2.9%
Pain – leg	0	0	1	1	2.9%
Periodontitis	0	1	0	1	2.9%
Pleurisy	0	1	0	1	2.9%
Pneumonia	0	1	1	2	5.9%
Possible seizure	0	0	1	1	2.9%
Respiratory problems	0	1	6	7	20.6%
Renal mass	0	0	1	1	2.9%
Retinal hemorrhage	0	1	0	1	2.9%
Retroperitoneal hematoma (left side)	0	1	0	1	2.9%
Shingles	0	0	1	1	2.9%
Shortness of breath	0	1	2	3	8.8%
Stroke* (adverse events included cerebellar hemorrhage, contrast induced encephalopathy transient, delayed minor occipital, diplopia and mass effect)	0	3	2	5	14.7%
Transient ischemic attack (TIA)	0	1	0	1	2.9%
Unsteady gait	0	0	1	1	2.9%
Urinary tract infection	0	1	1	2	5.9%
Uterine bleeding	0	1	0	1	2.9%
Vessel dissection	1	0	0	1	2.9%
Weakness, left side	0	0	1	1	2.9%
Weakness, right side	0	0	1	1	2.9%

*Stroke is defined as radiologically confirmed stroke or increase in NIHSS that persists for ≥ 24 hours.

Clinical Trial Results - ANSWER Study

The Adjunctive Neurovascular Support for Wide-Neck-Aneurysm Embolization and Reconstruction (ANSWER) Clinical Study is a prospective, multi-center, single-arm, non-randomized study designed to evaluate the safety and probable benefit of the PulseRider in patients undergoing treatment for bifurcation basilar or carotid terminus aneurysms. An overview of the clinical trial is provided in the following table:

Title:	**Adjunctive Neurovascular Support for Wide-Neck-Aneurysm Embolization and Reconstruction (ANSWER) Clinical Study**
Name of Device:	Pulsar Vascular PulseRider® Aneurysm Neck Reconstruction Device
Study Design:	A prospective, multi-center, single-arm, non-randomized study.
Objective:	The objective of this study is to assess the safety of the PulseRider in the minimally invasive endovascular treatment of basilar or carotid terminus bifurcation intracranial aneurysms.
Study Duration:	The anticipated timeline for this study is as follows: • Anticipated patient enrollment in 12 months • Anticipated completion of follow-up 12 months after last patient enrolled
Patient Population:	Patients who meet the protocol entry criteria with at least one bifurcation intracranial aneurysm that is acceptable for minimally invasive treatment.
Sample Size:	The objective is to enroll up to 35 evaluable patients.
Number of Sites:	Up to 15 sites worldwide may participate in this multi-center study.
Patient Follow-Up:	Patients will undergo a follow-up assessment immediately post-procedure, prior to hospital discharge and at 30-days, 180-days and 365-days post procedure. *NOTE: Although subjects will be followed to 365-days post procedure, it is expected that data to 180-days will be utilized for regulatory submission(s) in support of approval for commercialization.*
Study Endpoints:	Primary Endpoints: • Safety: Neurological death and major ipsilateral or downstream stroke to 180-days post-procedure • Technical Success: Device placement success and ability to retain coils within the aneurysm (as judged by the treating physician at the time of the procedure). Core lab will review images at a later time. • Rate of aneurysm occlusion at Day zero (0) and 180-days Additional Evaluations to 180-days and at 365-day follow up • Rate of aneurysm occlusion at 365 days • Device movement or migration defined as any relative change in the position of the device with respect to the parent and/or daughter vessels that is greater than 2 mm by conventional catheter angiography (180 days) and by conventional catheter angiography or MR angiography or CTA (365 days) • Stenosis defined as > 50% at implant site by conventional catheter angiography at 180 days and MR angiography or conventional catheter angiography or CTA at 365 days • Rate of incidence of new neurological deficits • Complication rate (neurological and non-neurological)

Study Population

The study population consisted of both male and female subjects, at least 18 years of age who presented with a wide neck (≥ 4 mm or dome to neck ratio < 2) basilar or carotid terminus aneurysm located at a bifurcation. Subjects with acutely ruptured aneurysms were excluded from the study. The aneurysm parent vessel measurements were required to be between 2.7 mm and 4.5 mm to be suitable for the procedure. Patients were required to take dual anti-platelets therapy starting prior to the procedure.

Inclusion Criteria - Candidates for this study were required to meet all of the following criteria:

a) Patient who presents with an angiographically confirmed, wide neck (≥ 4 mm or dome to neck ratio < 2 mm) intracranial aneurysms located at a bifurcation of the basilar artery or carotid terminus artery
b) The target aneurysm is in a vessel with a diameter of 2.7 mm to 4.5 mm.
c) The patient is 18 years or older at the time of consent
d) The patient has signed the IRB/EC approved informed consent form
e) In the opinion of the physician, placement of the PulseRider is technically feasible and clinically indicated
f) Subject has mental capacity and is willing and able to comply with protocol requirements and follow-up

Exclusion Criteria - Candidates were excluded if ANY of the following conditions applied:

a) Unstable neurological deficit (condition worsening within the last 90 days)
b) Subarachnoid Hemorrhage (SAH) within the last 60 days
c) Irreversible bleeding disorder
d) modified Rankin scale (mRS) score ≥ 3
e) Patient has another aneurysm which, in the Investigator's opinion, will require treatment within the follow up period (365-days)
f) Platelet count < 100 x 10^3 cells/mm^3
g) Inability to tolerate, adverse reaction or contraindication to taking aspirin or clopidogrel
h) A history of contrast allergy that cannot be medically controlled
i) Known allergy to nickel
j) Relative contraindication to angiography (e.g., serum creatinine > 2.5 mg/dL)
k) Woman with child-bearing potential who cannot provide a negative pregnancy test
l) Evidence of active infection (fever with temperature > 38 °C and/or WBC > 15,000)
m) Other conditions of the heart, blood, brain or intracranial vessels that carry a high risk of neurologic events
n) Evidence of disease or condition expected to compromise survival or ability to complete follow-up assessments during the 365-day follow-up period
o) Extracranial stenosis greater than 50% in the parent artery requiring access to the lesion
p) Intracranial stenosis greater than 50% in the treated vessel

q) Extreme vessel tortuosity that prohibits appropriate control of the micro-guide wire and/or the PulseRider delivery wire

Demographic data

Thirty-four (N = 34) subjects were recruited and treated in the ANSWER study. No subjects have withdrawn and no subjects have been discontinued by an investigator. One subject died of metastatic disease after the 180-day follow-up. The mean age was 60.9 years with a preponderance of women (85.3% (n/N = 29/34)) as is common in studies of intracranial aneurysms. Nine (9) subjects had undergone previous treatment for the target aneurysm with coil embolization. Five (5) subjects (14.7% (n/N = 5/34)) had a previous subarachnoid hemorrhage that occurred more than 60 days prior to the PulseRider procedure. Two (2) subjects had a previous stroke (5.9% (n/N = 2/34)) and 24 (70.6% (n/N = 24/34)) had concurrent hypertension. Baseline characteristics of the patient population are shown in the following tables.

Demographics

Demographics	
Age (yr): Mean ± Std (Min – Max)	60.9 ± 13.4 (26 – 86)
Male (n)	14.7% (5/34)
Female (n)	85.3% (29/34)

Subject History

Characteristic	% (n/N)
Medical History	
Subarachnoid Hemorrhage	14.7% (5/34)
Stroke	5.9% (2/34)
Coronary Artery Disease	5.9% (2/34)
History of Myocardial Infarction	2.9% (1/34)
Hypertension	70.6% (24/34)
Diabetes	11.8% (4/34)
Smoking	
Never Smoked	26.5% (9/34)
Previous Smoker	32.3% (11/34)
Current Smoker	41.2% (14/34)
Prior Treatment of Target Aneurysm	
Coil Embolization • Basilar • Carotid Terminus • Total	 23.5% (8/34) 2.9% (1/34) 26.5% (9/34)
Surgery – no patients had prior open surgery for the target aneurysm	0% (0/34)

Aneurysm Location

Location	# of Patients (n)	% (n/N)
Basilar	27	79% (27/34)
Carotid Terminus	7	21% (7/34)

Aneurysm Size

Measurement	N	Mean	Std	Min	Max
Dome width (mm)	34	7.0	3.2	2.8	16.3
Neck length (mm)	34	5.2	2.2	2.3	11.6
Dome to neck ratio	34	1.4	0.3	0.5	1.9
Parent vessel pre-aneurysm (mm)	34	3.1	0.3	2.7	4.2

Data analysis and results

The study is sized to provide a characterization of the adverse event profile associated with the device and to summarize its performance using traditional statistical techniques. The sample size for this trial was not derived via traditional power methods as no formal statistical hypothesis testing was planned. A total of thirty-four (34) subjects were implanted with the device, providing an adequate sample size to allow for the calculation of confidence limits for the primary performance endpoints that are meaningful and interpretable. Thirty-four subjects are also adequate to provide a characterization of the safety profile associated with the device.

The study results demonstrate that the PulseRider has been placed successfully in 34/34 (100%) study subjects. There were no reported neurological deaths or major ipsilateral/downstream strokes within 180 days of the PulseRider procedure. And occlusion (Raymond I/II) at 180 days was observed to be 87.9% (n/N = 29/33).

Primary Endpoints

Safety: Neurological Death and Major Ipsilateral or Downstream Stroke through 180 (+/-45) days
There were no reported neurological deaths or major ipsilateral/downstream strokes within 180 days of the PulseRider procedure. There were five (5) strokes reported in five patients of which four (4) were peri-procedural and one (1) delayed. Two of the patients with peri-procedural strokes recovered completely, and the other two patients with peri-procedural strokes as well as the patient with the delayed stroke recovered with sequelae such as ongoing blurred vision. In addition, one patient from the 34 total patients treated had a transient ischemic attack (TIA) peri-procedure.

The one-sided upper limit of the 95% confidence interval for neurological death or major ipsilateral/downstream stroke to 180-days post-procedure is 8.4% based on the observed rate of 0% (n/N = 0/34) using the Clopper-Pearson one-sided upper 95% confidence limit.

Neurological Death and Major Ipsilateral or Downstream Stroke through 180 (+/-45) days

	% (n/N)	Upper 95% Confidence Limit
Neurological Death	0% (0/34)	--
Major Stroke – Ipsilateral or Downstream*	0% (0/34)	--
Composite	0% (0/34)	8.4%

*****Major stroke is defined and analyzed as a stroke which is present after seven days and increases the NIHSS of the patient by ≥ 4, based on the pre-specified primary safety endpoint in the clinical protocol.

Although not pre-specified in the clinical protocol, the available modified Rankin Scale (mRS) scores were also analyzed to determine the severity of a stroke in support of understanding the safety profile of the PulseRider. The table below presents the pre-procedure, post-procedure, 30-day and 180-day mRS scores for the 5 patients who exhibited a stroke during the course of the clinical study.

Modified Rankin Scale (mRS) Scores for 5 Patients with Stroke Event before and after the Procedure, 30 Days, and 180 Days Follow-Up

Patient ID	Pre-Operative Visit	Post-Procedure	30-Day Follow-up	180-Day Follow-up
005-006	1	1	1	1
008-001	1	1	1	4
008-003	0	0	0	0
015-006	0	0	0	0
016-002	0	4 decreased to 2 within 2 days	0	1

A 90-day mRS was not conducted as part of the clinical study; therefore, the 180-day mRS was compared to the patient's pre-operative mRS to understand the severity of the stroke symptoms. The safety outcome based on both neurological death and stroke resulting in a mRS ≥ 3 at 180 days post procedure is presented in the following table.

Safety Outcome Assessed Based on Neurological Death and Stroke Resulting in mRS ≥ 3 at 180 (+/-45) Days*

	% (n/N)
Neurological Death	0% (0/34)
Stroke resulting in mRS ≥ 3	2.9% (1/34)

*The 90-day mRS was not conducted and only 180-day long-term follow-up was available. The 180-day mRS was assessed by office visit by a non-blinded assessor to the treatment.

Technical Success: Device placement success and ability to retain coils within the aneurysm
The PulseRider has been placed successfully in 34/34 (100%) study subjects. There have been no cases of an attempted PulseRider placement without success. In 34/34 (100%) cases, the treating physicians viewed the procedure as a technical success; they were able to access the target aneurysm, deploy the device accurately, and detach the device successfully.

Primary Endpoint- Technical Success

	% (n/N)	95% CI
Technical Success	100% (34/34)	91.6%, 100%

Rate of aneurysm occlusion at day zero (0) and 180-days
The success rate with respect to the primary endpoint of aneurysm occlusion (Raymond I) at day zero is 52.9% (n/N = 18/34). The success rate with respect to the primary endpoint of aneurysm occlusion (Raymond I/II) at 180-days is 87.9% (n/N = 29/33 subjects). The lower limit of the one-sided 80% confidence interval is 80.5%. Of the 29 subjects who had an aneurysm occlusion of Raymond I/II at 180-days, none of the subjects had clinically significant stenosis > 50%.

Aneurysm Occlusion

Report of Raymond Score			
Score	**Day Zero** n/N (%)	**180 Days**[1] n/N (%)	**365 Days** n/N (%)
Raymond I	18/34 (52.9%)	20/33 (60.6%)	6/8 (75%)
Raymond II	9/34 (26.5%)	9/33(27.3%)	2/8 (25%)
Raymond III	7/34 (20.6%)	4/33 (12.1%)	0/8 (0%)

[1]One enrolled subject had MRA performed instead of an angiogram and is excluded from this analysis.

Blinded core lab adjudicated Raymond I and II, combined = 87.9% at 180-days.

Raymond Score	180 days % (n/N)	Lower 80% Confidence Limit
I/II	87.9% (29/33[1])	80.5%[2]

[1]One enrolled subject had MRA performed instead of an angiogram and is excluded from this analysis.
[2] Based on the observed rate of 87.9% (n/N = 29/33) using the Clopper-Pearson one-sided lower 80% confidence limit.

The PulseRider is an adjunctive device to support the neck of the aneurysm and it is intended to be used in conjunction with embolic coils. In all cases the PulseRider was used with embolic coils placed in all lesions. The volume of coils is always at the discretion of the treating physician. There were two secondary procedures performed. One (1) subject with a basilar aneurysm treated in two previous procedures with coils alone had a third recanalization of the aneurysm and was treated with PulseRider and coils in January 2015. In another subject, the physician attempted to re-coil the aneurysm after the 180-day follow-up angiography but aborted the procedure due to concern of occluding the posterior cerebral artery (PCA). This remains a Raymond III.

ANSWER Study Conclusions

Safety
The ANSWER study was designed to evaluate safety and probable benefit of the PulseRider Aneurysm Neck Reconstruction Device in patients with wide neck, unruptured aneurysms, at a bifurcation of the carotid terminus or basilar artery. The data provided in support of the safety profile of the PulseRider is favorable. There were no neurological deaths associated with the device and five (5) strokes in 5 patients of which two (2) patients recovered completely, 2 patients had minor deficits, and only 1 patient with a poor safety outcome based on a mRS of 4 at 180 days post-procedure.

Probable Benefit
There is a low rate of peri-procedural complications (8.8% or n/N = 3/34 permanent neurological events) and a satisfactory outcome (mRS 0 – 2) was achieved in 94.1% of patients (n/N = 32/34) at 180-day follow up. In this subset of challenging aneurysms involving the carotid terminus and basilar apex, immediate Raymond I or II occlusions were obtained in the majority of cases (79.4% or n/N = 27/34) and this score improved to 87.9% (n/N = 29/33) at six month follow up. One patient was excluded from the 6 month aneurysm occlusion analysis because they received a MRA instead of an angiogram, which ensures consistency and accuracy of measurement techniques and the study results.

Risk/benefit analysis
The data support the reasonable assurance of safety and probable benefit of this device when used in accordance with the indications for use. Although the number of subjects in the ANSWER study with aneurysms at the carotid terminus is small (n=7), the results are similar when compared to the basilar group. The overall risk to benefit ratio is adequate for the intended population for whom the benefit of currently available treatments is limited.

Concomitant Medical Therapy
Typical antiplatelet and anticoagulation regimen used for interventional intracranial procedures is recommended at the discretion of the treating physician. This typically consists of pre-procedure dual antiplatelet therapy for three to five days (if possible), intraoperative intravenous anticoagulant therapy, intravenous anticoagulant therapy for 24 hours post-procedure, dual antiplatelet therapy for at least 90 days post-procedure, and antiplatelet monotherapy for life.

Refer to the manufacturer's labeling for potential side effects or complications that may result from the use of antiplatelet or anticoagulant medications.

Required Accessories
In addition to the PulseRider® device, the following items are required for the procedure:
- An electrolytic detachment power supply (refer to the power supply Directions for Use).
- Fresh batteries for the power supply for each procedure.
- A second Power Supply to be used as back-up.
- One non-tapered 6F (2.0 mm) guide catheter with a 90 cm minimum effective length.
- A continuous flush setup including two rotating hemostasis valves (RHVs), heparinized saline, one 3-way stopcock, and one 1-way stopcock.
- One sterile 20 gauge (0.9 or 0.7 mm) uncoated stainless steel hypodermic needle to provide electrical ground during implant detachment. (**Warning: DO NOT** use Teflon coated needles.)
- Alcohol-dampened gauze to clean delivery wire proximal end before connecting power supply detachment cable.

Compatibility Information
PulseRider Delivery Microcatheter
Neurovascular microcatheter (commercially available) – refer to manufacturer's Instructions for Use
- Minimum Inner Diameter (ID) of 0.5 mm (0.021")
- Maximum Length of 155 cm

Note: Compatibility with the following microcatheters has been verified:
  - Ev3 Marksman Catheter
  - Codman Prowler Select Plus
  - Ev3 Rebar-18

Coil Delivery Microcatheter
Neurovascular microcatheter (available separately from manufacturer) - refer to manufacturer's Instructions for Use
- Maximum Outer Diameter (OD) of 2F (0.66 mm)

Power Supply
Electrolytic Detachment Power Supply (commercially available) – refer to manufacturer's Instructions for Use
- Power < 2 W
- Output Current 2.0 mA maximum

Note: Compatibility with the following power supplies has been verified:
  - Boston Scientific Detachable Coil Power Supply (451008-3)
  - Covidien/Ev3 Detachment System (NDS-1)
  - Target InZone Detachment System (with accessory grounding cable)

Procedure Instructions
Note: The recommended procedure is to perform implant detachment after the initial frame of embolic coils is created, but before the final packing is performed.

Detachment Power Supply Preparation
1. Prepare the power supply in accordance with its Instructions for Use.

Aneurysm Access/Assessment and PulseRider Implant Selection
2. Prepare the guide catheter and connect the RHV to the guide catheter hub. Maintain continuous heparinized saline flush through guide catheter using the RHV side port. A double hemostasis valve adaptor may be useful in minimizing the number of attached accessories while allowing sufficient connections for saline drip lines, etc.
3. For dual-catheter techniques using a single guide catheter, ensure the RHV arrangement allows the implant delivery microcatheter and the coiling microcatheter to be placed through dedicated touhy fittings so that the fitting can be used to stabilize each microcatheter against unintended movement from movement of the other microcatheter sharing the same guide catheter lumen.
4. Place the guide catheter into the appropriate artery in accordance with its Instructions for Use. Prepare the microcatheter and guide wire for use in accordance with their Instructions for Use. Connect the RHV to the microcatheter hub. Maintain continuous heparinized saline flush through microcatheter using the RHV side port.
5. Prepare the microcatheter and guide wire for use in accordance with their Instructions for Use. Connect the RHV to the microcatheter hub. Maintain continuous heparinized saline flush through the microcatheter using the RHV side port.
6. Using conventional catheterization techniques and fluoroscopic guidance, place the microcatheter proximal to the vessel bifurcation.
7. Remove the guide wire from the microcatheter. Maintain continuous heparinized saline flush through the microcatheter using the RHV side port.
8. Use angiography to determine the aneurysm location, neck size, side branch angles, and parent vessel diameter.

9. Select the appropriate size implant based on the recommended sizing guidelines in **Table 1** and the directions in the Implant Size and Shape Selection section of this document.

Note: It is recommended that the implant arch is in contact with at least one side of the aneurysm neck with some overlap. The amount of overlap is at the physician's discretion, depending on the vascular anatomy and aneurysm orientation. See Implant Size and Shape Selection section of this document.

PulseRider Device Preparation and Introduction

10. Inspect the device package to ensure it has not been damaged. Do not use the device if the sterile barrier is damaged or if the "Use By" date marked on the packaging has passed.
11. Open the pouch and remove the packaging card containing the package hoop and device.
12. Inspect for device damage. The implant should be unconstrained within the protective housing and should be attached to the distal tip of the delivery wire. The introducer should be loaded on the delivery wire proximal to the implant and extending through the RHV into the protective housing. Do not use the device if the implant or delivery wire appear damaged in any way.
13. Carefully remove the delivery wire and implant from the packaging card without bending the delivery wire.
14. Flush the protective housing and introducer with sterile, saline, with or without heparin,through the RHV luer fitting until saline fills the introducer and drips from the proximal end.

    Caution: Do not flush the introducer with any other materials as they may damage the hydrophilic coating resulting in increased friction and/or delamination and shedding of the coating during use. If the delivery wire and implant are removed during the procedure, the system should be withdrawn into the introducer sheath and remain in the introducer sheath to protect the coating and the implant until it is reintroduced into the delivery catheter. The coating will maintain its integrity for a minimum of four hours after the coating has been hydrated

15. Gently untwist the introducer sheath by hand. This will allow free movement of the delivery wire within the introducer.

Note: The cap on the protective housing may need to be restrained manually during this flushing procedure to ensure the saline flows into and through the introducer.

16. Slowly retract the delivery wire into the introducer to constrain entire implant.
17. After constraining the implant, the RHV valve may be loosened and the introducer removed from the protective housing.
18. Remove the delivery wire and constrained implant/introducer as a unit from the package hoop. Do not allow the implant to deploy from the introducer tip or to retract further into the introducer.
19. Pass the introducer through the delivery microcatheter RHV and into the microcatheter hub.
20. With the introducer tip fully seated in the microcatheter hub, slowly advance the delivery wire until the implant passes through the hub and into the microcatheter lumen.
21. Remove the introducer proximally from the delivery wire, taking care to not allow the delivery wire to move relative to the microcatheter.
22. Place the introducer in the sterile field for future possible use if removal and/or reintroduction of the device is needed.
23. Advance the delivery wire and implant until the implant distal radiopaque markers are about 1 cm from the microcatheter tip.
24. Tighten the RHV on the microcatheter to hold the delivery wire in position.
25. Attach the torque device to the delivery wire a few centimeters proximal to the RHV.
26. Carefully advance the device and microcatheter as a unit until the microcatheter tip is positioned just proximal to the aneurysm neck and at the level of the vessel bifurcation.
27. Gently pull back on the delivery wire and microcatheter until the excess slack is removed and the tip of the microcatheter begins to move.
28. Achieve proper orientation of the device before deployment. Extend the tips 2 mm or less past the end of the catheter and observe the orientation of the distal markers.
29. If the device needs to be rotated, retract the device into the catheter 5 cm or more while simultaneously turning the device ¼ turn or less.
30. Extend the tips again, no more than 2 mm to check orientation. Repeat as required to turn the device to the required orientation.

Implant Positioning and Orientation

Note: The best fluoroscopic view for positioning the implant for deployment is the view that shows the parent vessel and aneurysm neck. This view may not be the same view as the working position for aneurysm embolization.

Cutaway View

Fluoroscopic View

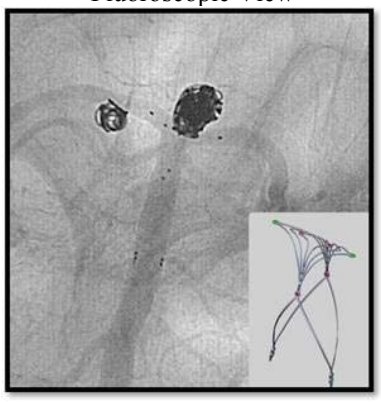


Figure 6: Implant and Aneurysm

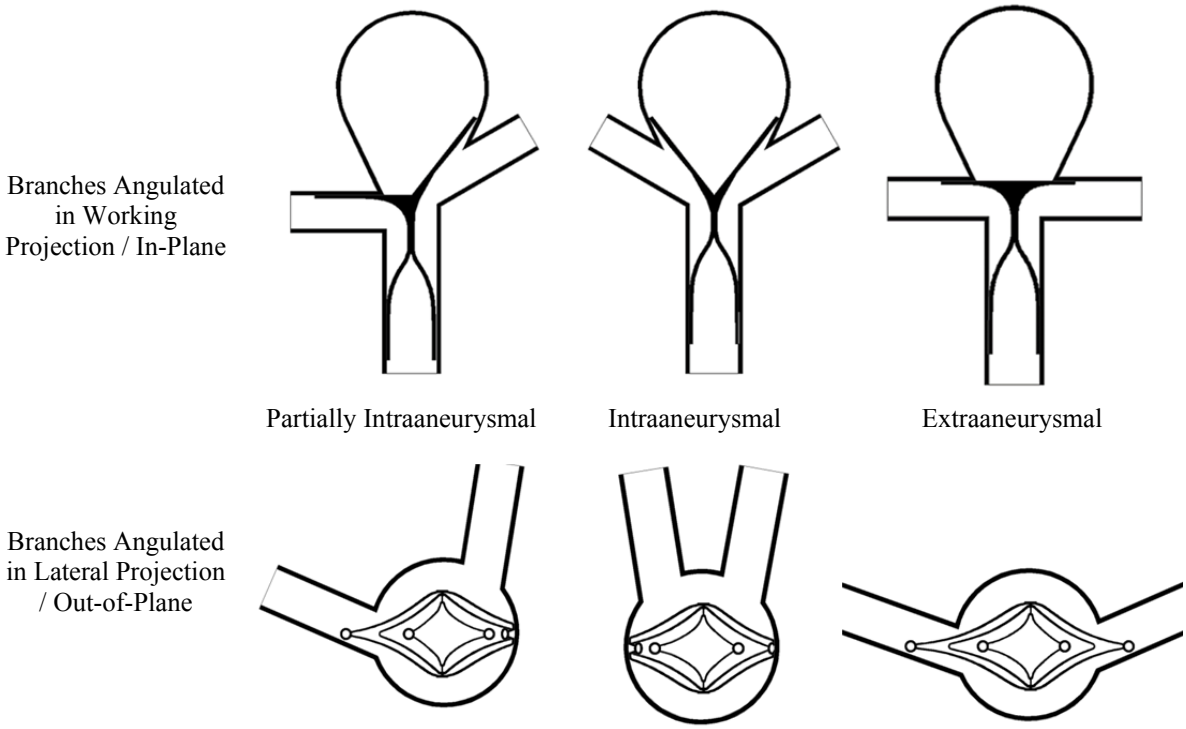
Note: If the device is not responsive to this process, remove and replace with a new device. For best positioning performance, it is important to rotate the implant as it is being retracted and to advance it without rotation. This minimizes the stored energy in the delivery wire during deployment.

WARNING: Do not attempt to torque or rotate the device with the distal section deployed (see Figure 5). Torqueing the device with the implant deployed and engaged in the vasculature may result in fracture of the device which could make removal difficult or impossible and may cause vessel damage or dissection.

31. Position the implant so that the implant distal markers are directly proximal to the aneurysm neck and then continue to Deployment.

Deployment

32. The implant is intended to be deployed with the distal arch section positioned in alignment with the branch arteries to retain coils within the aneurysmal sac while preventing coils from entering the branch arteries.
33. In cases where the branch arteries are incorporated partially or completely into the aneurysm the arch may be positioned partially or completely within the aneurysm. However, the anchor section must remain outside the aneurysm in order to stabilize the position of the arch.
34. The PulseRider arch is intended to conform to the branch vessels in both longitudinal and lateral directions. In cases where the branch arteries are angulated such that the arch will not conform to the vessel as desired in either the working projection or the out-of-plane directions, the PulseRider may be placed in a partial or fully intraaneurysmal position as shown below.



Implant Positioning Examples (Same as Figure 4 on p. 3)

35. To deploy the implant, hold the delivery wire stationary while withdrawing the microcatheter to unsheath the implant until the microcatheter tip is proximal to the delivery wire marker.
36. The implant may be retracted within the microcatheter to optimize implant position and orientation as necessary by advancing or retracting the microcatheter to sheath the implant into the microcatheter lumen.
37. When the implant is in position and deployed at the desired location, ensure the microcatheter has been sufficiently retracted to allow the implant to unsheath fully. Verify the implant is fully deployed by confirming that the delivery wire marker is distal to the microcatheter tip marker.
38. Place the coil delivery microcatheter through the PulseRider implant and into the sac of the aneurysm. Proceed carefully with coiling the aneurysm.

Note: The embolic coil microcatheter must not exceed 2.0 F (0.66 mm).
Note: The implant is retractable prior to detachment ONLY.

Implant Detachment

Note: The PulseRider implant should remain attached to the delivery wire until a sufficient basket of coils has been placed within the aneurysm to prevent the PulseRider implant from being unintentionally advanced into the aneurysmal sac.

39. Refer to the power supply Instructions for Use.
40. Insert the hypodermic needle at patient's groin. (DO NOT use a coated needle.)
41. Attach the power cables per the power supply Instructions For Use.
42. Before attaching the chosen detachment system ensure the delivery wire has been wiped with alcohol and is clean and dry.
43. Use fluoroscopy to confirm that the implant has remained in the desired position and that the delivery wire marker is distal to the microcatheter tip. (This ensures that the predetermined delivery wire detachment zone is exposed and ready for detachment.)
44. Initiate the detachment process per the power supply Instructions For Use. Monitor the power supply displays. Detachment may take up to several minutes.
45. After the power supply signals detachment, verify under fluoroscopy that the implant has detached. Slowly pull back on delivery wire while watching fluoroscopically to make sure the implant does not move. Movement may indicate that there has been a "false detachment". Repeat detachment cycle if a false detachment is suspected.
46. Once implant detachment is confirmed, disconnect the detachment system from the delivery wire, and slowly withdraw the delivery wire from the microcatheter.
47. Aneurysm embolization may begin immediately.

Symbols

										
Manu-facturer	Store in cool dark place	Keep dry	Non-pyrogenic	For use by trained physician	Do not reuse	Do not resterilize	Do no use if damaged	Use by	MR conditional	Attention: see Instructions For Use

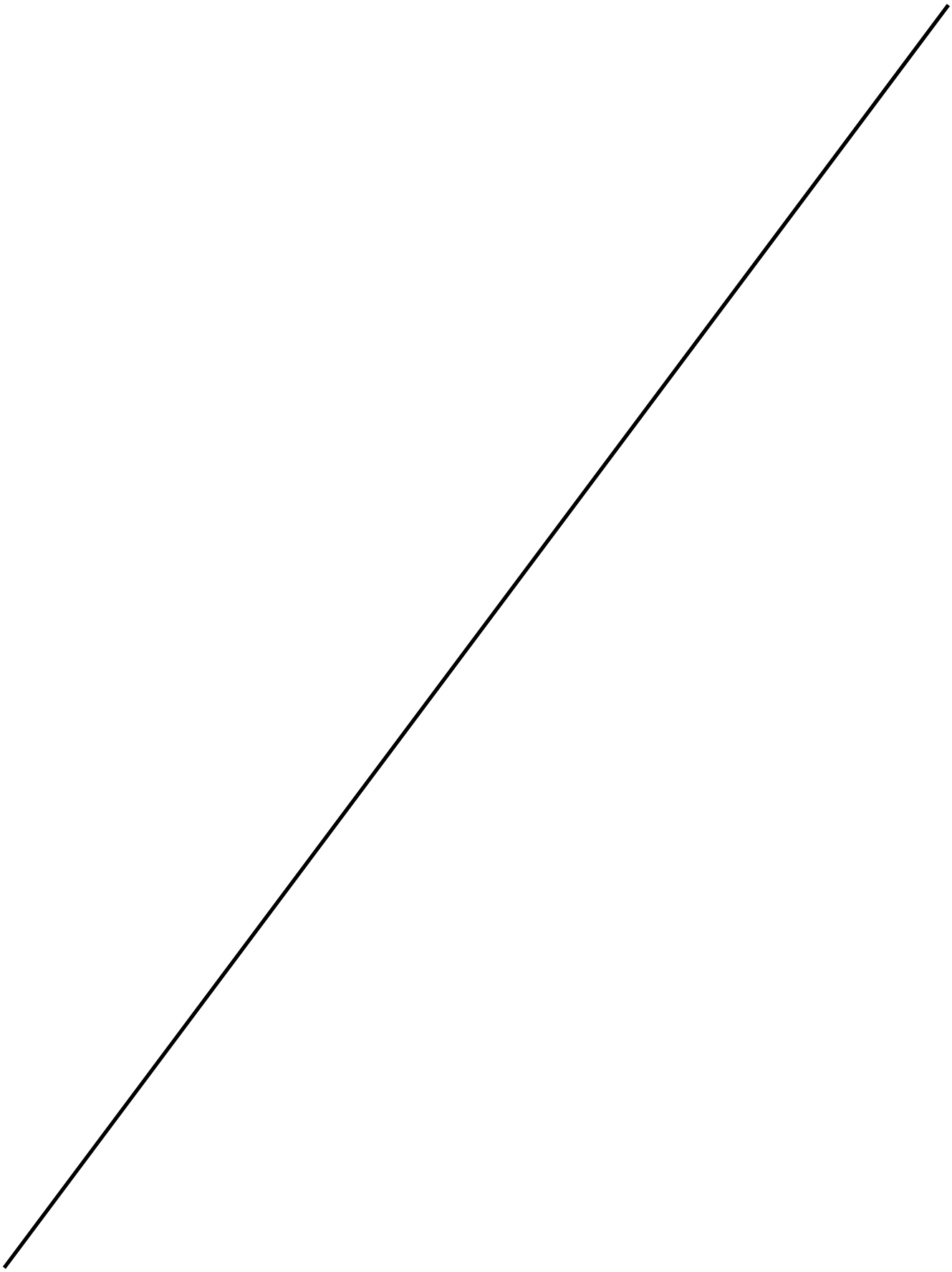
Contents	European Authorized Representative	Lot Number	Catalog Number	Serial Number	Sterilized Using Ethylene Oxide

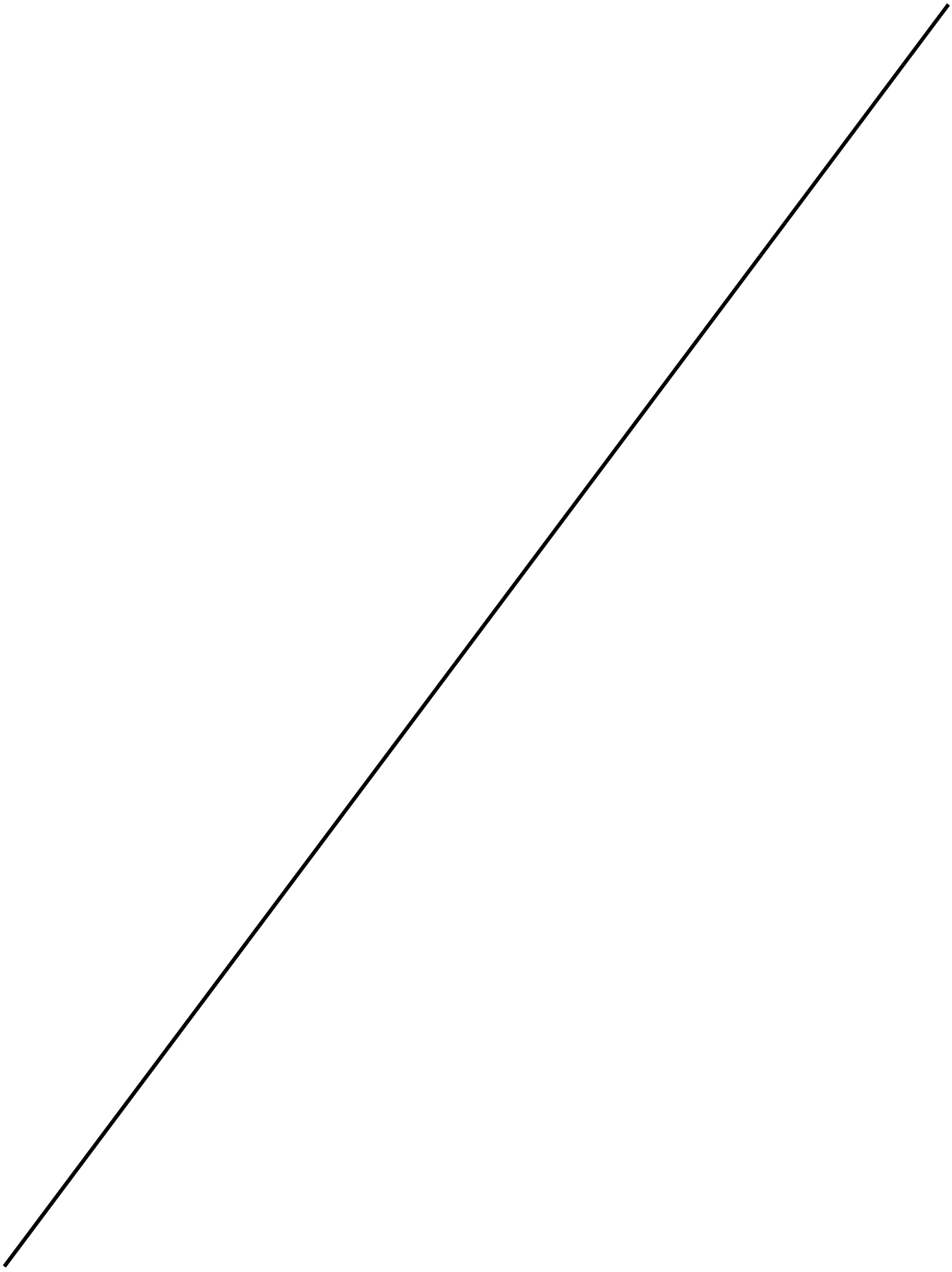
Caution: Federal law restricts this device to sale by or on the order of a physician

Pulsar Vascular, Inc.
130 Knowles Drive, Suite E
Los Gatos, CA 95032 USA
+1 408 260 9264
www.pulsarvascular.com

DISCLAIMER OF WARRANTY

ALTHOUGH PULSERIDER®, HEREAFTER REFERRED TO AS 'PRODUCT', HAS BEEN MANUFACTURED UNDER CAREFULLY CONTROLLED CONDITIONS, *PULSAR VASCULAR, INC.*, HEREAFTER REFERRED TO AS 'PULSAR', HAS NO CONTROL OVER CONDITIONS UNDER WHICH THE PRODUCT IS USED. **PULSAR DISCLAIMS ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE, WITH RESPECT TO THE PRODUCT, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, SATISFACTORY QUALITY, NON-INTERFERENCE, ACCURACY OF INFORMATIONAL CONTENT, OR ARISING FROM A COURSE OF DEALING, LAW, USAGE, OR TRADE PRACTICE. PULSAR SHALL NOT BE LIABLE TO ANY PERSON OR ENTITY FOR ANY MEDICAL EXPENSES OR ANY DIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES CAUSED BY ANY USE, DEFECT, FAILURE OR MALFUNCTION OF THE PRODUCT, WHETHER A CLAIM FOR SUCH DAMAGES IS BASED UPON WARRANTY, CONTRACT, TORT OR OTHERWISE. NO PERSON OR ENTITY HAS ANY AUTHORITY TO BIND PULSAR TO ANY REPRESENTATION OR WARRANTY WITH RESPECT TO THE PRODUCT.** THE EXCLUSIONS AND LIMITATIONS SET OUT ABOVE ARE NOT INTENDED TO AND SHOULD NOT BE CONSTRUED SO AS TO CONTRAVENE MANDATORY PROVISIONS OF APPLICABLE LAW. IF ANY PART OR TERM OF THIS DISCLAIMER OF WARRANTY IS DETERMINED TO BE ILLEGAL, UNENFORCEABLE OR IN CONFLICT WITH APPLICABLE LAW BY A COURT OF COMPETENT JURISDICTION, THE VALIDITY OF THE REMAINING PORTIONS OF THIS DISCLAIMER OF WARRANTY SHALL NOT BE AFFECTED.






PulsarVascular