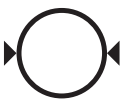
Cordis™

100574015.3

Instructions For Use (eIFU)
Cordis PALMAZ MULLINS XD™ Pulmonary Stent System

Explanation of symbols on labels and packaging:

	**Use-by date**
	**Do not re-use**
	**Sterilized using irradiation**
	**Lot number**
	**Caution**
	**Consult instructions for use**
	**Catalogue number**
	**Do not use if package is damaged**
	**Keep dry**
	**Keep away from sunlight**
	**Non-Pyrogenic**
	**Do not resterilize**
	**Manufacturer**
	**Caution: Federal (USA) law restricts this device to sale by or on order of a physician.**
	**n units per box**
	**MR Conditional**
	**Usable length**
	**Diameter**

PALMAZ MULLINS XD™ Pulmonary Stent

STERILE. The PALMAZ MULLINS XD™ Pulmonary Stent is sterilized with gamma radiation. Nonpyrogenic. The stent is radiopaque. For single use only. Do not resterilize, do not reuse the device.

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

I. Device Name

The device brand name is the **PALMAZ MULLINS XD Pulmonary Stent**.

II. Description

The **PALMAZ MULLINS XD Pulmonary Stent** is a balloon-expandable, laser cut stent made from 316L stainless steel tubing.
The stent is supplied unmounted and in five (5) nominal unexpanded lengths: 19 mm, 25 mm, 29 mm, 39 mm, and 59 mm. Nominal diameter expansion ranges and the length of each size stent after it has been expanded to its nominal diameter is shown in Table 1.
One (1) stent implant card is also included in the packaging.

Table 1: PALMAZ MULLINS XD Pulmonary Stent Product Specifications

Stent Description		Stent Length	
Product Code	**Nominal Diameter and Length (mm)**	**Unexpanded (mm)**	**Expanded (mm)***
PM1910PXD	10 x 19 12 x 19	19	17 16
PM2510PXD	10 x 25 12 x 25	25	23 21
PM2910PXD	10 x 29 12 x 29	29	27 25
PM3910PXD	10 x 39 12 x 39	39	36 34
PM5910PXD	10 x 59	59	55

* Expanded stent length data are based on in vitro testing.

III. Indications for Use

The **PALMAZ MULLINS XD Pulmonary Stent** is indicated for the non-emergency treatment of pulmonary artery stenosis in pediatric patients who are at least 10kg in weight with two ventricle anatomy.

IV. Contradictions

Contraindications associated with the use of the **PALMAZ MULLINS XD Pulmonary Stent** include:

- Active infection
- Aneurysm, dissection or in-situ thrombus formation at the treatment site
- Inability to traverse narrowed segment safely
- Vessel too small for the delivery system

V. Warnings

- The **PALMAZ MULLINS XD Pulmonary Stent** is intended for single use only. Do not resterilize and/or reuse the device.
- Reuse of this product, including after reprocessing and/or re-sterilization, may cause a loss of structural integrity which could lead to a failure of the device to perform as intended and may lead to a loss of critical labeling/use information all of which present a potential risk to patient safety.
- Do not use if the inner package is opened or damaged.
- Use the stent prior to the "Use By" date specified on the package.
- Once fully deployed, the stent cannot be repositioned without risk of damage to the heart and vessels. Surgical intervention may be required to remove an embolized stent.
- Stenting across a bifurcation could compromise future diagnostic or therapeutic procedures.
- Persons with allergic reactions to nickel may suffer an allergic response to this implant. Prior to implantation, patients should be counseled on the materials contained in the device, as well as potential for allergy/hypersensitivity to these materials.
- Safety and effectiveness have not been established in patients whose weight is less than or equal to 10.0 kg, who have a single ventricle anatomy, or who are undergoing emergency or immediate post-operative interventions.

VI. Precautions

- Store in a cool, dark, dry place.
- The device should only be used by physicians who are trained in interventional techniques in congenital heart disease such as percutaneous transluminal angioplasty, placement of stents, and right and left heart catheterization procedures.
- To avoid the possibility of dissimilar metal corrosion, do not implant stents of different metals in tandem where overlap or contact is possible, with an exception - stents made of 316L stainless steel are compatible with stents made of nickel titanium alloy.
- The operator needs to choose a balloon and delivery system that is appropriate for the size of the patient and the target lesion.
- Recrossing a partially or fully deployed stent with adjunct devices must be performed with caution.
- Refer to the Instructions for Use supplied with any interventional devices to be used in conjunction with the **PALMAZ MULLINS XD Pulmonary Stent** for their intended uses, contraindications and potential complications.

VII. Potential Complications

Potential complications associated with the catheterization procedure and implantation of the device may include, but are not limited to, the following:

- Arrhythmia
- Bleeding
- Death
- Fistula formation
- Hemoptysis
- Hypotension
- Infection
- In-stent thrombosis
- Ischemia/reperfusion injury
- Jailed side branches of the pulmonary arteries
- Myocardial infarction
- Obstruction
- Pulmonary artery aneurysm, dissection or rupture
- Pulmonary artery thrombosis/thromboembolism
- Pulmonary edema
- Restenosis
- Stent fracture with loss of structural integrity
- Stent malposition, dislodgement/migration or embolization requiring transcatheter or surgical adjustment or retrieval
- Stroke or transient ischemic attack
- Vessel perforation/injury/dissection/rupture/tear

VIII. Directions for Use

1. **Insertion of Catheter Sheath Introducer (CSI) and Guidewire**
   - **a.** Gain access at the preferred or alternate site using an appropriate CSI and guidewire.
   - **b.** Post access, introduce an angiographic catheter into the pulmonary arteries and capture an angiogram using standard technique.
2. **Selection of Stent Size**
   - **a.** Obtain minimum diameter, stenotic length and measurements of the adjacent, non-stenotic anatomy (normal reference vessel) via imaging, including but not limited to angiography, to determine the stent(s) required.
     Note: For severe stenosis, it may be appropriate for the stent to be implanted with a smaller than target diameter with the intention of serial dilation over time.
     Note: Make sure measurements are obtained accurately and beware of vessel pulsatility. Make sure to measure the frame with the maximum target diameter.
   - **b.** The stent selected should cover the entire length of stenosis.
3. **Preparation of Stent**
   - **a.** Open the carton to reveal the pouch containing the stent.
   - **b.** Inspect the stent package for damage to the sterile barrier. Remove the stent from the package and rinse in sterile saline.
4. **Preparation of Stent Delivery Balloon Catheter**
   Note: An appropriate size balloon catheter and sheath should be chosen at the discretion of the user and prepared per the manufacturers' Instructions for Use.

   Considerations for Balloon selection include –

– A balloon size that can firmly secure the stent and have a high enough inflation pressure to expand the stent without rupture
  - o lower inflation pressure balloons have higher risk of balloon rupture during inflation/stent expansion
  - o inflating a balloon above the rated burst pressure may risk balloon rupture during expansion of the stent

Considerations for Sheath selection include -

- The sheath length is determined by the distance from the insertion site to cross the target lesion, which is determined by the patient size
- The Sheath French size should be large enough to ensure easy passage of the device to the stenotic site without stent slippage off the balloon

5. Preparation of Stent Delivery System

Note: The following describes the general procedure; actual technique can vary by operator.

a. Slide the stent over the distal end of the balloon while maintaining the balloon fold. Center the stent on the balloon, ensuring the radiopaque marker bands are equidistant from the ends of the stent.
Caution: It is crucial the stent is properly centered on the balloon prior to implantation to avoid stent malposition.

b. With the balloon under negative pressure, manually crimp the stent onto the balloon in a circumferential fashion: apply even, concentric pressure along the length of the stent while fully rotating the assembly. Ensure the stent securely adheres to the balloon.
Caution: The stent must be properly crimped onto the balloon to prevent it from sliding off during the stent deployment process. Excessive crimping, however, can cause pinhole ruptures of the balloon.

c. Slightly pre-inflate both ends to ensure balloon is expanded evenly.
Caution: Ensure that balloon inflation does not cause interference with the CSI.

6. Preparation for Stent Deployment

a. Insert an appropriate guidewire that is at least twice the length of the stent delivery system and advance it across the lesion.
Note: If the operator determines that pre-dilation is necessary to determine vascular compliance, standard percutaneous transluminal angioplasty (PTA) techniques with an appropriate balloon may be used. Maintain access with the applicable guidewire.
Caution: Take care not to overdilate (i.e., dilate beyond the normal vessel diameter) to avoid vascular injury.

b. Exchange the short sheath for a long sheath of appropriate size to accommodate the stent delivery system.

c. Advance the CSI completely across the lesion.

7. Introduction of Stent Delivery System

Caution: Make sure there are no wires or angiographic catheters that may be entrapped by the stent.

a. Flush guidewire lumen of the stent delivery system. Backload the balloon/stent unit onto the guidewire. Place the assembly through the hemostatic valve until resistance is met.
Caution: Ensure the stent does not slip off the balloon when passing through the valve of the sheath. Lock the inflator to maintain low pressure in the balloon during insertion of the stent/delivery assembly. If resistance is met during the stent/balloon insertion through the sheath, make sure there is no unusual distortion or kinking of the sheath.
Note: Fluoroscopy is recommended to observe passage of the stent delivery system over the guidewire to the target lesion.

b. Continue to advance the stent delivery system over the guidewire through the hemostatic valve to the target lesion.

8. Stent Deployment

a. Keeping the CSI immobile, observe fluoroscopically as the stent delivery system is advanced through the CSI to the site of the stenosis.
Caution: If excessive or unusual resistance is encountered at any time during the process, do not force passage. If resistance occurs during movement through the sheath, the stent/catheter may have to be withdrawn carefully.

b. Under fluoroscopy, use the balloon marker bands and the radiopaque stent to position the stent centrally along the area of the stenosis within the sheath.
Caution: During positioning, verify that the stent is still centered within the balloon marker bands and has not been dislodged. Precise stent positioning sometimes requires multiple hand injections to visualize the stent in relation to adjacent segments and side branches for optimal positioning before inflation.

c. After stent positioning, hold the delivery system immobile and retract the CSI to uncover the stent.
Caution: After completely retracting the CSI, do not re-advance it over the positioned stent to avoid dislodging the stent.

d. Capture an angiogram to ensure the stent and balloon are in the right location.

e. Using an inflation device, steadily inflate the balloon under fluoroscopy to the nominal pressure recommended on the catheter label. Expand the diameter of the stent to the diameter of the adjacent, normal reference vessel.
Caution: Full expansion depends on the nature and compliance of the stenosis. Familiarize yourself with the nominal and rated burst pressures of the balloon that is selected.
Caution: Do not exceed the catheter rated burst pressure. If needed during stent expansion, adjustments to the stent must be performed under fluoroscopy.
Caution: Before inflation, make sure the sheath is withdrawn far back to allow for full inflation of the balloon.
Caution: If the stent cannot be delivered to the target location, attempts to retract the stent/catheter into the sheath may result in stent dislodgement. The stent/catheter/sheath should be removed as a single unit.
Note: Ensure even expansion on both ends of the balloon.
Note: Never use air or any gaseous medium to inflate the balloon.

9. Delivery System Withdrawal

a. After deploying the stent, deflate the balloon by pulling a vacuum, allowing adequate time for the balloon to fully deflate prior to removal.

b. While maintaining negative pressure on the balloon, slowly withdraw the balloon out of the stent and into the delivery sheath.
Caution: Observe removal of the balloon under fluoroscopy to ensure that the balloon disengages from the stent.
Caution: When the balloon is withdrawn from the stent, pay attention to stent stability to ensure there is no migration.
Note: If the wings of the balloon become caught in the stent struts during withdrawal, the stent can become dislodged. To reduce the likelihood of this: (1) advance the sheath to the edge of the stent to prevent it from backing out further and then slowly withdraw the balloon; or (2) inflate and slowly deflate the balloon inside the stent such that as the balloon is deflated, the sheath is advanced, so it stays over the partially inflated balloon and centered as you cross the stent.

c. Withdraw the deflated delivery system into the CSI.

d. Perform a post-stent angiogram to evaluate stent and vascular integrity. The operator may choose to re-measure pressures.

e. Discard the delivery system, guidewire and CSI.
Note: In growing patients, it is anticipated that further dilation of the implanted **PALMAZ MULLINS XD Pulmonary Stent** may be necessary to accommodate somatic growth. When the stent is expanded beyond the nominal diameter, there will be varying degrees of foreshortening.

Table 2: PALMAZ MULLINS XD Pulmonary Stent Foreshortening Chart

Nominal Stent Length	Nominal Stent Diameter 10mm		Nominal Stent Diameter 12mm	
	Expanded Length	Percentage Foreshortening	Expanded Length	Percentage Foreshortening
19mm	17.32mm	6.64%	16.24mm	12.41%
25mm	23.14mm	6.92%	21.50mm	13.60%
29mm	26.66mm	6.84%	25.46mm	10.91%
39mm	35.62mm	6.79%	34.20mm	10.64%
59mm	55.41mm	4.81%	N/A	N/A

IX. Magnetic Resonance Imaging (MRI) Safety Information

A waiting period is not necessary for patients after obtaining a Cordis **PALMAZ™** Stent and prior to entering the MRI environment. The measured magnetically induced force is sufficiently less than the weight of the stent, therefore the risk of migration due to magnetic force is very low.

MRI Safety Information

A patient with the **PALMAZ** Stent may be safely scanned under the following conditions. Failure to follow these conditions may result in injury to the patient.

Device Name	Cordis **PALMAZ** Stents
Static Magnetic Field Strength (B_0)	1.5 T and 3.0 T
Maximum Spatial Field Gradient	20 T/m (2000 Gauss/cm)
Radio Frequency (RF) excitation	Circularly polarized (CP)
RF Transmit Coil Type	Whole body transmit coil Head RF transmit-receive coil
RF receive coil type	Any
Maximum whole body Specific Absorption Rate (SAR) (W/kg)	2.0 W/kg (Normal Operating Mode)
Limits on scan duration	2.0 W/kg whole body average SAR for 15 minutes of continuous RF (a sequence or back-to-back series/scan without breaks) followed by a wait time of 10 minutes if this limit is reached.
Magnetic Resonance (MR) image artifact	The presence of this implant produced an image artifact of approximately 12mm when imaged with a spin echo pulse sequence and a 3.0 T MRI system
If information about a specific parameter is not included, there are no conditions associated with that parameter	
Non-clinical testing has demonstrated that the **PALMAZ** Stent is MR Conditional in single and overlapped configuration up to a maximum of 154mm as defined in ASTM F2503-13.	

X. Summary of Clinical Study

"Implantation of Endovascular Stents for Dilation of Pulmonary Artery Branch Stenosis in Patients with Congenital Heart Disease - The Pulmonary Artery Stent Study" (PASS) was a retrospective, multicenter, analysis utilizing data captured in the Congenital Cardiovascular Interventional Study Consortium (CCISC) Registry. The primary objective of this registry study was to assess safety and effectiveness outcomes associated with the real-world use of the Cordis **PALMAZ GENESIS® Transhepatic Biliary Stent** in a single main branch pulmonary artery of patients with confirmed unilateral, central branch pulmonary artery stenosis and bi-ventricular circulation. **NOTE:** The design and construction of the **PALMAZ MULLINS XD Stent** are identical to the **PALMAZ GENESIS Transhepatic Biliary Stent.** The **PALMAZ GENESIS Transhepatic Biliary Stent** is branded as the **PALMAZ MULLINS XD Stent** for the pediatric pulmonary aortic stenosis indication.

1. Study Endpoints:

PASS evaluated the following endpoints:

Technical success was achieved if ALL of the following criteria were met:

- Subject was alive
- Successful access, delivery and retrieval of the investigational device delivery system
- Deployment and correct positioning of the investigational device in the intended location
- No need for additional unplanned surgery or re-intervention related to the investigational device or access procedure

The **primary safety endpoint** was the occurrence of any somewhat serious or serious adverse event (SAE) attributed to the stent or implantation procedure within 12 months of the procedure. "Somewhat Serious" was defined as any event which resulted in significant transient impairment of a body function or transient damage to a body structure; required significant intervention to prevent permanent impairment of a body function or damage to a body structure. "Serious" was defined as any event which was life-threatening; resulted in permanent impairment of a bodily function or permanent damage to a body structure; necessitated major intervention to prevent permanent impairment of a body function or permanent damage to a body structure.

The **primary effectiveness endpoint** was defined as an increase in the stented vessel minimum pulmonary artery diameter by ≥ 50% of the pre-stent diameter, as determined by post-implant catheterization angiography.

The **secondary effectiveness endpoint** was defined as the ability to maintain relief of stenosis (includes planned re-dilatation or re-dilatation due to somatic growth) in the stented pulmonary artery at 12 months post-stent implantation by follow-up echocardiogram, catheterization angiography or CT based on at least one of the criteria below:

- Maintenance of stented vessel minimum pulmonary artery diameter by ≥ 50% vs. original baseline (pre-stent implant)
- Maintenance of decreased systolic gradient by ≥ 50% vs. original baseline or maintenance of gradient < 20mmHg (when applicable – i.e., when the pre-stent gradient was ≥ 20 mmHg across stenotic vessel)
- Maintenance of RV/FA (right ventricle/femoral artery) systolic pressure ratio to ≤ 50% vs. original baseline (when applicable - i.e., when pre-stent RV/FA ratio was > 50%)

Both clinical/physiologic and imaging data collected before and immediately after the stent implantation as well as at one (1) year post-stent implantation (follow-up) were reported and analyzed. For effectiveness, each patient served as his or her own control. For safety, primary safety endpoint was descriptively compared with safety rates derived from literature.

2. Inclusion and Exclusion Criteria

Patients were required to meet ALL of the following criteria to be included in this study:

1. Males and females with biventricular circulation of an age and size sufficient to require branch pulmonary artery dilation for congenital or postoperative branch pulmonary artery stenosis
2. Unilateral pulmonary artery stenosis involving either the right or left main branch. The stenotic segment is confined to the right or left main branch with reduction of the lumen size of the normal adjacent vessel by at least 50%
3. Any of the following physiologic and anatomic data: a systolic pressure gradient across the stenosis of 20 mm Hg, right ventricular (RV) hypertension of at least 60% systemic pressure, stenosis diameter of half the normal adjacent vessel, objective evidence of decreased perfusion of ≤ 35% to the ipsilateral lung detected by a nuclear medicine perfusion study, MRI or other imaging modalities
4. Stenosis localized in a relatively straight segment of the central branch pulmonary artery starting from 2mm of the branch ostium and not involving the orifice of the lobar branch
5. Patients with a previous thoracotomy or sternotomy which places them at unusually high risk for surgery directed at branch pulmonary stenosis relief OR patients who have had previously unsuccessful attempts at balloon dilation of branch pulmonary artery stenosis, only to have recoil of the dilated vessel with restenosis
6. Only outpatient cases

Patients were excluded from this study if they met ANY of the following criteria:

1. Children whose weight was ≤ 10 kg prior to the stenting procedure
2. Children with additional branch pulmonary artery stenoses located in the lobar branches or beyond, bilateral stenoses, or stenoses involving the orifices of the branch pulmonary arteries
3. Patients with a single or one and a half ventricle circulation
4. A previous attempt at balloon dilation of resistant branch pulmonary artery stenosis which could not be expanded with conventional angioplasty balloons
5. Patients in whom vascular access and/or cardiac status did not permit the implantation of the **PALMAZ GENESIS Transhepatic Biliary Stent**
6. Patients with severe branch pulmonary artery stenoses such that the intended treatment plan was to implant a partially dilated stent and further dilate in a serial fashion in order to avoid vessel wall disruption
7. Patients with a previously placed pulmonary artery stent at the intended site
8. Patients who had received other types of stents in the pulmonary artery at the intended site
9. Early post-operative or urgent/emergent cases where there were compromised hemodynamics or other morbidities that might have confounded the catheterization procedure

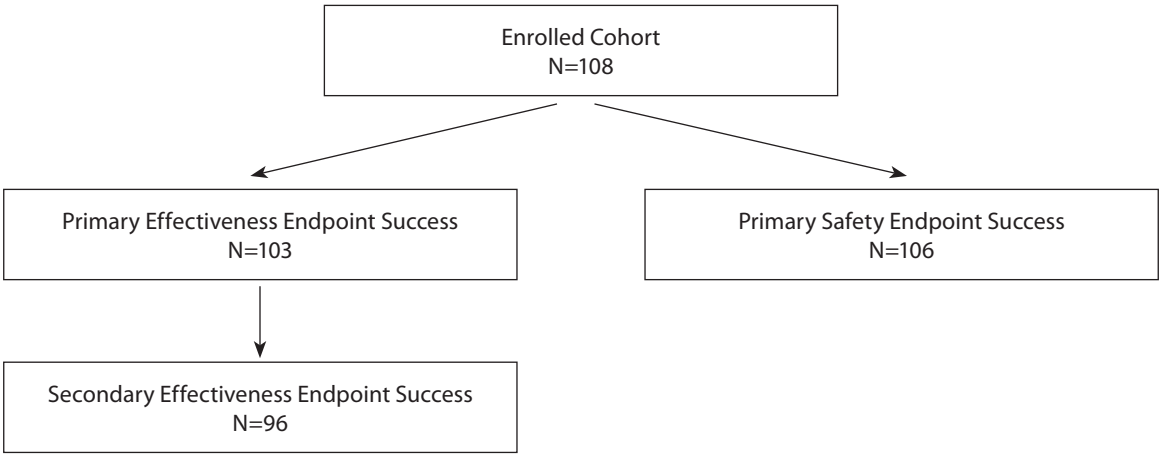
3. Patient Accountability

The accountability and breakdown/flow of all subjects in the total enrolled cohort is summarized as follows and diagrammed in Figure 1.

- Total Enrolled Cohort (N=108 subjects)
  - Failed implant (surgical removal) of the study stent due to complications/SAEs in two (2) subjects: technical and primary safety outcome failures and non-evaluable for primary effectiveness outcome (1.8%; 2/108)
  - Successful implant (technical success) in 106 subjects (98.1%; 106/108)
    - › Primary effectiveness outcome failure in three (3) subjects
    - › Primary effectiveness outcome success in 103 subjects (95.4%; 103/108)
      - » Inadequate follow-up data for secondary effectiveness outcome evaluation in six (6) subjects
      - » Adequate follow-up data for secondary effectiveness outcome obtained in 97 subjects (94.2%; 97/103)

› Secondary effectiveness outcome failure in one (1) subject
  ◊ Secondary effectiveness outcome success in 96 out of 97 evaluable subjects (99.0%; 96/97)

Figure 1: Patient Accountability in the Enrolled Cohort



4. Demographics and Baseline Characteristics

The study enrolled 108 subjects at 11 investigational centers across the United States and Canada between January 2006 and September 2016. As shown in Table 3, subjects ranged in age from 0.9 to 65.3 years with a mean age of 17.7 ± 9.5 years. Most subjects had a prior history of surgery (92.6%; 100/108) and had Tetralogy of Fallot as the primary diagnosis prior to study stent procedure (54.6%; 59/108). Mean weight of subjects at baseline was 32.9 ± 22.0 kg.

Table 3: Demographics and Baseline Characteristics

Characteristics	N=108
Age (years)	
Mean ± SD	17.7 ± 9.5
Median	16.5
Range (Min, Max)	(0.9, 65.3)
Female (%)	51.9% (56/108)
Weight (kg)	
Mean ± SD	32.9 ± 22.0
Median	24.9
Range (Min, Max)	(10.1, 122)
Prior History of Surgery (%)	92.6% (100/108)
Primary Diagnosis (%)	
Tetralogy of Fallot	54.6% (59/108)
Pulmonary atresia with ventricular septal defect (VSD)	15.7% (17/108)
Transposition of the Great Arteries	1.9% (2/108)
Patent Ductus Arteriosus with Pulmonary Artery Stenosis	3.7% (4/108)
Right Ventricular Conduit with Pulmonary Artery Stenosis	4.6% (5/108)

Truncus	10.2% (11/108)
Unknown	9.3% (10/108)

The distribution of enrolled subjects by weight and age are further shown in Table 4 below.

Table 4: Age and Weight Distribution of Enrolled Subjects

Age Range	Weight Range	N
>1 month to 2 years	11-13kg	3
>2 years to 12 years	10.1-32kg	24
>12 years to 21 years	11-77.4kg	53
>21 years	18.8-122kg	28

5. Results

The **PALMAZ GENESIS Transhepatic Biliary Stent** was successfully implanted in 98.1% (106/108) of subjects who underwent the implant procedure. Seventy of 108 subjects (64.8%) underwent study treatment in the left pulmonary artery.

Technical Success:

All 108 subjects were treated with the study stent; six (6) subjects were treated with a second study stent in order to cover the initial lesion or due to initial stent malposition. One hundred six (106) of 108 subjects (98.1%) achieved technical success. Two (2) subjects were technical failures due to intraprocedural complications (stent malposition in one subject and stent embolization in the other subject), which resulted in surgical removal of the study stent in both subjects.

Primary Safety Endpoint:

Two of the 108 subjects experienced primary safety events. Stent malposition in one subject and stent embolization in the other subject resulted in surgical removal of the study stent in both subjects. These safety events are the same technical failures described in the preceding section. The observed primary safety event rate was 1.9% (2/108).

Other Adverse Events:

In addition to the two (2) SAEs in two (2) subjects described in the "Primary Safety Endpoint" section above, the following non-serious, adverse events (AE) were reported in four (4) other subjects:

- Jailing of the contralateral (right) pulmonary artery without flow obstruction beyond the study stent
- Non-sustained supra-ventricular tachycardia resulting in overdrive pacing
- Non-sustained ventricular fibrillation/ventricular tachycardia requiring shock and pacing
- Reperfusion injury of the intervened vessel which required prolonged ventilation for 24 hours

The above events were all anticipated. No stent fractures, aneurysms, dissections, somewhat serious adverse events, or unanticipated AEs were reported for any of the subjects in the study cohort.

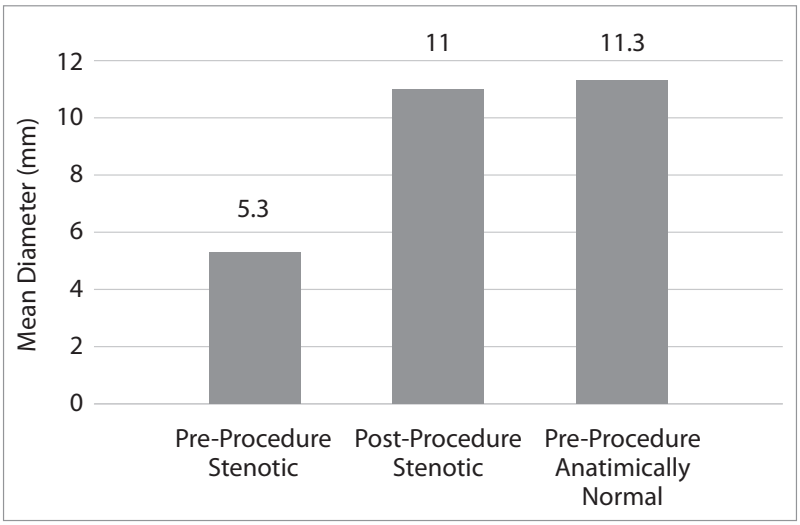
Primary Effectiveness Endpoint:

In the 106 evaluable subjects (those who achieved technical success and for whom pulmonary artery diameters pre and post-procedure were obtained by cardiac catheterization), the mean value for the diameter of the stenotic segment of the pulmonary artery (i.e., minimum diameter) in subjects pre-procedure was 5.3 ± 2.1 mm and increased to 11.0 ± 3.1 mm post-procedure. The post-procedure mean vessel diameter favorably compared with the mean diameter (11.3 ± 3.9 mm) of the adjacent, anatomically normal segment of the pulmonary artery measured pre-procedure (Figure 2).

The primary effectiveness endpoint (increase in the stented vessel minimum pulmonary artery diameter by ≥ 50% of the pre-stent diameter, as determined by post-implant catheterization angiography) was achieved in 95.4% (103/108) of all subjects. Of the five subjects who did not achieve the primary effectiveness endpoint, two (2) subjects were technical failures and three (3) additional subjects did not experience at least a 50% increase in minimum diameter of the stented pulmonary artery post-procedure.

The mean percentage increase in the diameter of the stenotic segment of the pulmonary artery was 142.5 ± 87.8% with a lower bound 95% confidence interval (CI) of 125.6% (Table 5).

Figure 2: Stenotic Pre- and Post-Procedure Pulmonary Artery Diameters Relative to Normal Pre-Procedure Diameter by Catheterization (n=106)



	Mean	SD	Median	SD Error Mean	Range
Pre-Procedure Stenotic Pulmonary Artery Diameter (mm)	5.3	2.1	5.0	0.2	1.0 - 11.0
Post-Procedure Stenotic Pulmonary Artery Diameter (mm)	11.0	3.1	10.0	0.3	5.1 - 18.2
Pre-Procedure Anatomically Normal (Largest) Pulmonary Artery Diameter (mm)	11.3	3.9	11.2	0.4	4.0 - 22.5

Table 5: Percentage Increase in Stenotic Pulmonary Artery Diameters from Pre- to Post-Procedure by Catheterization (n=106)

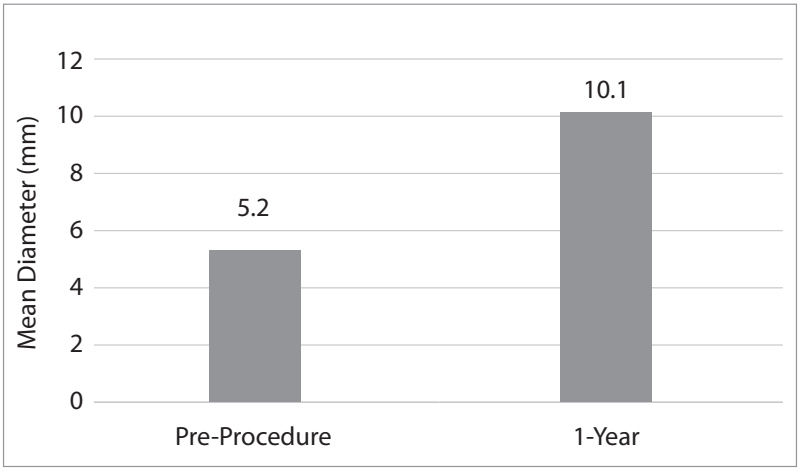
Variable	Percentage (%)
Mean	142.5
Standard Deviation	87.8
Median	117.2
95% Confidence Interval (Lower)	125.6
95% Confidence Interval (Upper)	159.4
Minimum	28.6
Maximum	500.0

Secondary Effectiveness Endpoint:

There were 97 subjects who met the primary effectiveness outcome and had adequate and applicable follow-up data for comparison with baseline data and thereby, were evaluable for the secondary effectiveness outcome. The secondary effectiveness outcome was achieved in 99% of subjects (96/97).

- **Evaluation by Pulmonary Artery Diameter at 1 year:** In the 94 of 97 subjects with echocardiographic measurements at baseline and 1-year follow-up, there was a clinically meaningful improvement in the mean diameter from 5.2 ± 1.8 mm at baseline to 10.1 ± 2.9 mm at 1-year follow-up (Figure 3). A ≥ 50% increase in diameter from baseline to 1-year follow-up was observed in 91 of these 94 subjects.

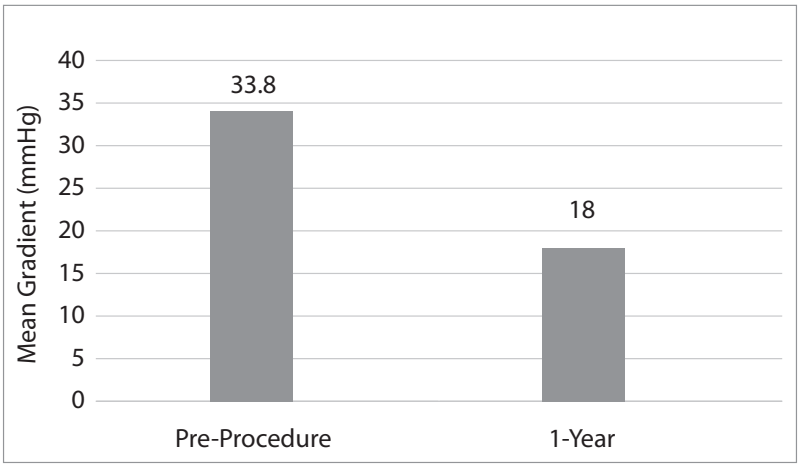
Figure 3: Mean Stenotic Pulmonary Artery Diameters Pre-Procedure and at 1-Year Follow-Up by Echocardiography (n=94)



	Mean	SD	Median	SD Error Mean	Range
Pre-Procedure Echo Stenotic Vessel Diameter (mm)	5.2	1.8	5.1	0.2	2.0 - 10.5
1-Year Echo Stenotic Vessel Diameter (mm)	10.1	2.9	9.1	0.3	7.0- 18.0

- **Evaluation by Systolic Gradient at 1 year:** Of the 46 of 97 subjects with echocardiographic measurements at baseline and 1-year follow-up and for whom evaluation of this endpoint was applicable, there was a clinically meaningful decrease observed in the mean systolic gradient from 33.8 ± 11.7 mmHg at baseline to 18.0 ± 10.8 mmHg at 1-year follow-up (Figure 4). The 1-year gradient was ≥ 50% lower than the baseline gradient and/or < 20mmHg in 32 of these 46 subjects.

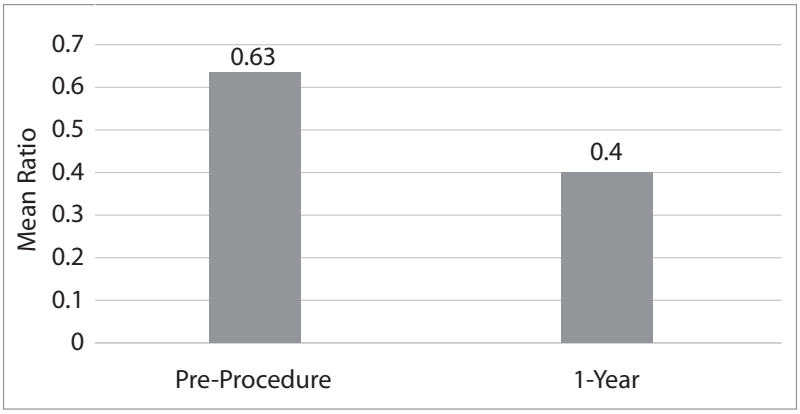
Figure 4: Mean Vessel Gradients Pre-Procedure and at 1-Year Follow-Up by Echocardiography (n=46)



	Mean	SD	Median	SD Error Mean	Range
Pre-Procedure Echo Vessel Gradient (mmHg)	33.8	11.7	31.0	1.7	20.0 - 62.0
1-Year Echo Vessel Gradient (mmHg)	18.0	10.8	16.0	1.6	4.0 - 54.0

Evaluation by RV/FA Systolic Pressure Ratio at 1 year: Twenty-eight of the 97 evaluable subjects had evaluable echocardiographic measurements at baseline and 1-year follow-up, there was a clinically meaningful decrease observed in the mean RV/FA systolic pressure ratio from 0.63 ± 0.1 at baseline to 0.40 ± 0.15 at 1-year follow-up (Figure 5). The 1-year RV/FA ratio was ≤ 50% in 21 of these 28 subjects.

Figure 5: Mean RV/FA Pressure Ratios Pre-Procedure and at 1-Year Follow-Up by Echocardiography (n=28).



	Mean	SD	Median	SD Error Mean	Range
Pre-Procedure Echo RV/FA Pressure Ratio	0.63	0.1	0.63	0.02	0.51 - 0.96
1-Year Echo RV/FA Pressure Ratio	0.4	0.15	0.37	0.03	0.2 - 0.73

Of the 97 total subjects evaluated for the secondary effectiveness outcome, 96 met at least one of the three (3) criteria, thereby meeting the secondary effectiveness outcome:

- 57 subjects met one (1) criterion
- 30 met two (2) criteria
- 9 met all three (3) criteria.

Re-Intervention:
The observed proportion of subjects with a successful initial stent implant who underwent re-intervention during 1-year follow-up was 0.9% (1/108); the re-intervention in this subject was performed due to intimal proliferation.

Although patients were only followed for 1-year, additional data about re-interventions beyond 1 year was available for nine subjects. In these nine subjects, re-interventions were necessary to accommodate normal somatic growth and involved successful re-dilation and expansion of the study stents beyond their nominal diameters to match somatic growth.

The following characteristics are associated with the re-interventions in these 10 subjects:

- The mean timeframe for re-intervention was 40.1 months (range 10 to 84 months) after initial stent implant.
- For the nine (9) subjects who underwent re-intervention due to somatic growth:
  - The mean age was 13.8 years (range 7 to 20.8 years).
  - The mean post-re-intervention pulmonary artery diameter was 13.1 mm (range 10.8 to 16 mm).
- All subjects who underwent re-intervention met the original primary effectiveness outcome of the study based on pre-procedure and post-procedure pulmonary artery diameter measurements obtained by cardiac catheterization.
- No stent fractures were reported.

6. Conclusions

This retrospective, single-arm, multi-center clinical study was designed to evaluate the safety and effectiveness of the **PALMAZ MULLINS XD Stent** for the non-emergency treatment of pulmonary artery stenosis primarily in pediatric patients. The primary safety endpoint (observed proportion of subjects treated with the study stent with SAEs reported through 12 months) was 1.9%; 2/108 which is lower than the SAE rate observed in the literature (9%). The lower bound of the 95% CI for the primary effectiveness outcome (mean percentage increase in pulmonary artery diameter by angiography) was 125.6% and clinically meaningful. Data through 12 months post-stent implant supports the successful use of the **PALMAZ MULLINS XD stent** for the non-emergency treatment of pulmonary artery stenosis in pediatric patients who are at least 10kg in weight with two ventricle anatomy.

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