Avalus™ Bioprosthesis

Designed for life.

Intentionally designed for durability and performance – from the frame materials and tissue treatment to leaflet manufacturing – the Avalus valve is made to last.
The Avalus valve delivers the durability and valve performance you expect – and that your patients deserve.

- Built circular to stay circular
- AOA™ tissue treatment
- Designed for 100% coaptation and 0% doubt
- Designed for future ViV
Built circular to stay circular

Circularity is crucial, but not all aortic valves maintain circularity. Noncircular or deformed surgical valves can have decreased durability and poor blood flow.\(^1\)\(^-\)\(^4\) The nondeformable polymer base of the Avalus surgical aortic valve is designed to:

- Enable efficient blood flow
- Allow regular leaflet motion
- Increase valve durability
- Help facilitate future valve-in-valve procedures

Risks may include infection, surgical complications, stroke, endocarditis, and death.

Not all valves maintain circularity

A study analyzing 152 MDCT scans of stented surgical aortic valves showed none or trivial deformation in 44\% of patients, mild deformation in 39\% of patients, and noncircularity in 17\% of cases.\(^5\)

Did you know?

The Avalus valve utilizes a nondeformable polymer (PEEK) base which allows the valve to maintain circularity during and post-implantation, which is critical for long-term hemodynamic performance and stability.\(^1\)\(^-\)\(^4\)

---

AOA™
tissue treatment

Valves treated with AOA implanted in over half a million patients. AOA treatment is utilized across multiple products, such as Mosaic™ aortic and mitral valves, Freestyle™ aortic valve, and Evolut™ transcatheter platform.

The benefits of AOA tissue treatment have been demonstrated through animal testing. No direct clinical evaluation of the benefits of AOA treatment in humans has been conducted.
Calcium reduction

Medtronic and Edwards each studied anti-calcification treatments in the mitral position of juvenile sheep. In both respective studies, AOA and Resilia™* treatments demonstrated similar significant reduction in calcium compared to the control group.

Did you know?
Subsequent storage in glutaraldehyde allows any remaining free aldehydes to crosslink.4, 5

<table>
<thead>
<tr>
<th>Calcium values (μg/mg)</th>
<th>Medtronic¹</th>
<th>Edwards², ³</th>
</tr>
</thead>
<tbody>
<tr>
<td>No treatment used on tissue</td>
<td>8.36</td>
<td>6.8</td>
</tr>
<tr>
<td>AOA-treated tissue</td>
<td>1.97</td>
<td>1.9</td>
</tr>
<tr>
<td>Original Edwards XenoLogiX-treated tissue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilia-treated tissue</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These tests may not be indicative of clinical performance and are for illustrative purposes only. The charts are not intended to be a comparison of the two devices as there is no head-to-head preclinical animal clinical study but rather are intended to illustrate the results of two similar animal studies. Multiple factors contribute to animal study outcomes and need to be considered in making any assessments across different studies.  

Designed for 100% coaptation and 0% doubt

The Avalus valve features a dual component, nondeformable base, and flexible stent posts designed for:

- Excellent leaflet coaptation¹
- Coapts smoothly and fully to effectively reduce central jet of blood flow
- Supra-annular placement

Design highlights

Avalus valve was designed to maximize the advantages of an internally mounted valve while reducing its key disadvantage, which is greater central regurgitation.

Facilitates future ViV patient care

- The polymer frame does not contain any metal to mitigate risk of metal-on-metal corrosion with transcatheter stent materials.
- The base frame is made from PEEK and impregnated with barium sulfate to provide radiopacity, which facilitates ViV procedures.
- Interior-mounted leaflets mitigate risk of coronary obstruction in ViV procedures.
- MRI-safe in all MR environments without conditions.

Did you know?
Both the Avalus and transcatheter Evolut™ valves are designed for the valve leaflets to be supra-annular.
Indications, safety, and warnings

If you are located in the United States, please refer to the brief statement(s) below to review applicable indications, safety, and warning information. See the device manual for a full list of information regarding the instructions for use, the implant procedure, indications, contraindications, warnings, precautions, and potential complications/adverse events. For further information, please call Medtronic at 1.763.514.4000 and/or consult the Medtronic website at medtronic.com.

If you are located outside the United States, see the device manual for a full list of information regarding instructions for use, the implant procedure, indications, contraindications, warnings, precautions, and potential adverse events. For further information, contact your local Medtronic representative and/or consult the Medtronic website at medtronic.com and select your appropriate country/region.

For applicable products, consult instructions for use on manuals.medtronic.com. Manuals can be viewed using a current version of any major internet browser. For best results, use Adobe Acrobat® Reader with the browser.

Avalus™ Bioprosthesis

**Indications:** The Avalus bioprosthesis is indicated for the replacement of diseased, damaged, or malfunctioning native or prosthetic aortic valves. **Contraindications:** None known. **Warnings/Precautions/Adverse Events:** Only physicians who have received proper training in valve replacement should use this device. Accelerated structural deterioration due to calcific degeneration of bioprosthesis may occur in: children, adolescents, young adults, and patients with altered calcium metabolism (e.g., chronic renal failure, or hyperparathyroidism). Adverse events can include: angina, cardiac dysrhythmias, endocarditis, heart failure, hemolysis, hemolytic anemia, hemorrhage, infection other than endocarditis, transvalvular or paravalvular leak, myocardial infarction, nonstructural valve dysfunction (leaflet entrapment/impingement, obstructive pannus ingrowth, suture dehiscence, inappropriate sizing or positioning, or other), pericardial effusion or tamponade, prosthesis regurgitation, prosthesis stenosis, prosthesis thrombosis, stroke, structural valve deterioration (calcification, leaflet tear or perforation, or other), thromboembolism, tissue dehiscence, and transient ischemic attack. These complications could lead to reoperation, explant of the bioprosthesis, permanent disability, or death. **Caution:** Federal law (USA) restricts these devices to sale by or on the order of a physician.

CoreValve™ Evolut™ TAVR System

**Indications:** The Medtronic CoreValve™ Evolut™ R, Evolut™ PRO+, and Evolut™ FX Systems are indicated for the relief of aortic stenosis in patients with symptomatic heart disease due to severe native calcific aortic stenosis who are judged by a heart team, including a cardiac surgeon, to be appropriate for transcatheter heart valve replacement therapy. The Medtronic CoreValve Evolut R, Evolut PRO+, and Evolut FX Systems are indicated for use in patients with symptomatic heart disease due to failure (stenosed, insufficient, or combined) of a surgical bioprosthetic aortic valve who are judged by a heart team, including a cardiac surgeon, to be appropriate for transcatheter heart valve replacement therapy (e.g., STS predicted risk of operative mortality score ≥ 8% or at a ≥ 15% risk of mortality at 30 days).

**Contraindications:** The CoreValve Evolut R, Evolut PRO+, and Evolut FX Systems are contraindicated in patients who cannot tolerate Nitinol (titanium or nickel), gold (for Evolut FX Systems alone), an anticoagulation/antiplatelet regimen, or who have active bacterial endocarditis or other active infections.

**Warnings:** General Implantation of the CoreValve Evolut R, Evolut PRO+, and Evolut FX Systems should be performed only by physicians who have received Medtronic CoreValve Evolut R, Evolut PRO+, or Evolut FX training. This procedure should only be performed where emergency aortic valve surgery can be performed promptly.

Ordering information

<table>
<thead>
<tr>
<th>Avalus valve order number</th>
<th>Valve size</th>
<th>Stent diameter (TAD)</th>
<th>Internal orifice diameter†</th>
<th>External sewing ring diameter</th>
<th>Valve profile height</th>
<th>Aortic protrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(2a)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>40017‡</td>
<td>17 mm</td>
<td>17 mm</td>
<td>15.5 mm</td>
<td>16 mm</td>
<td>25.0 mm</td>
<td>12.0 mm</td>
</tr>
<tr>
<td>40019</td>
<td>19 mm</td>
<td>19 mm</td>
<td>17.5 mm</td>
<td>18 mm</td>
<td>27.0 mm</td>
<td>13.0 mm</td>
</tr>
<tr>
<td>40021</td>
<td>21 mm</td>
<td>21 mm</td>
<td>19.5 mm</td>
<td>20 mm</td>
<td>29.0 mm</td>
<td>14.0 mm</td>
</tr>
<tr>
<td>40023</td>
<td>23 mm</td>
<td>23 mm</td>
<td>21.5 mm</td>
<td>22 mm</td>
<td>31.0 mm</td>
<td>15.0 mm</td>
</tr>
<tr>
<td>40025</td>
<td>25 mm</td>
<td>25 mm</td>
<td>23.5 mm</td>
<td>24 mm</td>
<td>33.0 mm</td>
<td>16.0 mm</td>
</tr>
<tr>
<td>40027</td>
<td>27 mm</td>
<td>27 mm</td>
<td>25.5 mm</td>
<td>26 mm</td>
<td>36.0 mm</td>
<td>17.0 mm</td>
</tr>
<tr>
<td>40029†</td>
<td>29 mm</td>
<td>29 mm</td>
<td>27.5 mm</td>
<td>28 mm</td>
<td>38.0 mm</td>
<td>18.0 mm</td>
</tr>
</tbody>
</table>

TAD: Tissue Annulus Diameter
†Measurement shows stent frame including tissue (2) and stent frame excluding tissue (2a).
‡40017 is only available in Japan; 40029 is only available in select countries, including Europe and Canada.

Accessories

<table>
<thead>
<tr>
<th>Order number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7420</td>
<td>Valve handle</td>
</tr>
<tr>
<td>7400S</td>
<td>Avalus™ sizers</td>
</tr>
<tr>
<td>T7400</td>
<td>Tray, accessory, Avalus™</td>
</tr>
</tbody>
</table>
Mechanical failure of the delivery catheter system and/or accessories may result in patient complications. Transcatheter aortic valve (bioprosthesis) Accelerated deterioration due to calcific degeneration of the bioprostheses may occur in: children, adolescents, or young adults; patients with altered calcium metabolism (e.g., chronic renal failure or hyperthyroidism).

Precautions: General Clinical long-term durability has not been established for the bioprosthesis. Evaluate bioprosthesis performance as needed during patient follow-up. The safety and effectiveness of the CoreValve Evolut R, Evolut PRO+, and Evolut FX Systems have not been evaluated in the pediatric population. The safety and effectiveness of the bioprostheses for aortic valve replacement have not been evaluated in the following patient populations: Patients who do not meet the criteria for symptomatic severe native aortic stenosis as defined: (1) symptomatic severe high-gradient aortic stenosis — aortic pressure gradient ≥ 40 mm Hg; (2) symptomatic severe low-flow, low-gradient aortic stenosis — aortic valve area ≤ 1.0 cm² or aortic valve area index ≤ 0.6 cm²/m², a mean aortic valve gradient < 40 mm Hg, and a peak aortic-jet velocity < 4.0 m/s; with untreated, clinically significant coronary artery disease requiring revascularization; with a preexisting prosthetic heart valve with a rigid support structure in either the mitral or pulmonic position if either the preexisting prosthetic heart valve could affect the implantation or function of the bioprosthesis or the bioprosthesis could affect the function of the preexisting prosthetic heart valve; patients with liver failure (Child-Pugh Class C); with cardiogenic shock manifested by low cardiac output, vasopressor dependence, or mechanical hemodynamic support; patients who are pregnant or breastfeeding. The safety and effectiveness of a CoreValve Evolut R, Evolut PRO+, or Evolut FX bioprosthesis implanted within a failed preexisting transcatheter bioprosthesis have not been demonstrated. Implanting a CoreValve Evolut R, Evolut PRO+, or Evolut FX bioprosthesis in a degenerated surgical bioprosthetic valve (transcatheter aortic valve in surgical aortic valve [TAV-in-SAV]) should be avoided in the following conditions: The degenerated surgical bioprosthetic valve presents with: a significant concomitant paravalvular leak (between the prosthesis and the native annulus), is not securely fixed in the native annulus, or is not structurally intact (e.g., wire frame fracture), partially detached leaflet that in the aortic position may obstruct a coronary ostium; stent frame with a manufacturer-labeled inner diameter < 17 mm. The safety and effectiveness of the bioprostheses for aortic valve replacement have not been evaluated in patient populations presenting with the following: Blood dyscrasias as defined as leukopenia (WBC < 1,000 cells/mm³), thrombocytopenia (platelet count < 50,000 cells/mm³), history of bleeding diathesis or coagulopathy; or hypercoagulable states; congenital unicuspid valve; mixed aortic valve disease (aortic stenosis and aortic regurgitation with predominant aortic regurgitation [3+4+]; moderate to severe [3+4+] or severe [4+] mitral or severe [4+] tricuspid regurgitation; hypertrophic obstructive cardiomyopathy; new or untreated echocardiographic evidence of intracardiac mass, thrombus, or vegetation; native aortic annulus size < 18 mm or > 30 mm per the baseline diagnostic imaging or surgical bioprosthetic aortic annulus size < 17 mm or > 30 mm; transarterial access unable to accommodate an 18 Fr introducer sheath or the 14 Fr equivalent EnVeo InLine™ Sheath when using models ENVEOR-US/D-EVPROP2329US or Evolut FX Delivery Catheter System with InLine™ Sheath when using model D-EVOLUTFX-3329 or D-EVOLUTFX-34; moderate to severe left subclavian/axillary access. For subclavian access, patients with a patent left internal mammary artery (LIMA) graft must present with access vessel diameters of ≥ 5.5 mm when using models ENVEOR-US/D-EVPROP2329US/D-EVOLUTFX-3329 or ≥ 6.5 mm when using model ENVEOR-N-US or ≥ 6 mm when using models D-EVOLUTFX3329US/D-EVOLUTFX-34, or patients must present with an ascending aortic (direct aortic) access site ≥ 60 mm from the basal plane for both systems. Implantation of the bioprosthesis should be avoided in patients with aortic root angulation (angle between plane of aortic valve annulus and horizontal plane/vertebrae) of > 30° for right subclavian/axillary access or > 70° for femoral and left subclavian/axillary access. For subclavian access, patients with a patent left internal mammary artery (LIMA) graft must present with access vessel diameters that are either ≥ 5.5 mm when using models ENVEOR-L-US/D-EVPROP2329US/D-EVOLUTFX-3329 or ≥ 6.5 mm when using model ENVEOR-N-US or ≥ 6.6 mm when using models D-EVOLUTFX3329US/D-EVOLUTFX-34. Use caution when using the subclavian/axillary approach in patients with a patent LIMA graft or patent RIMA graft. For direct aortic access, ensure the access site and trajectory are free of patent RIMA or a preexisting patent RIMA graft. For transfemoral access, use caution in patients who present with multplanar curvature of the aorta, angulation of the aortic arch, an ascending aortic aneurysm, or severe calcification in the aorta and/or vasculature. If ≥ 2 of these factors are present, consider an alternative access route to prevent vascular complications. Limited clinical data are available for transcatheter aortic valve replacement in patients with a congenital bicuspid aortic valve who are deemed to be at low surgical risk. Anatomical characteristics should be considered when using the valve in this population. In addition, patient age should be considered as long-term durability of the valve has not been established.

During Use: After the procedure, administer appropriate antibiotic prophylaxis as needed for patients at risk for prosthetic valve infection and endocarditis prophylaxis, administering antibiotic therapy per physician/clinical judgment. Conduct the procedure under fluoroscopy. Fluoroscopic procedures are associated with the risk of radiation damage to the skin, which may be painful, disfiguring, and long-term. The safety and efficacy of a CoreValve Evolut R, Evolut PRO+, or Evolut FX bioprosthesis implanted within a transcatheter bioprosthesis have not been demonstrated.

Potential Adverse Events: Potential risks associated with the implantation of the CoreValve Evolut R, Evolut PRO+, or Evolut FX transcatheter aortic valve may include, but are not limited to, the following: • death • myocardial infarction, cardiac arrest, cardiogenic shock, or cardiac tamponade • coronary occlusion, obstruction, or vessel spasm (including acute coronary closure) • cardiovascular injury (including rupture, perforation, tissue ejection, or dissection of vessels, ascending aorta trauma, ventricle, myocardium, or valvular structures that may require intervention) • emergent surgical intervention (e.g., coronary artery bypass graft, valve explant, percutaneous coronary intervention [PCI], balloon valvuloplasty) • prosthesis valve dysfunction (regurgitation or stenosis) due to fracture; bending (out-of-round configuration) of the valve frame; endocarditis. After the procedure, administer antibiotic prophylaxis as needed for patients at risk for prosthetic valve infection and accelerated deterioration due to calcific degeneration of the bioprostheses may occur in: children, adolescents, or young adults; patients with altered calcium metabolism (e.g., chronic renal failure or hyperthyroidism).

Please reference the CoreValve Evolut R, Evolut PRO+, and Evolut FX Instructions for Use for more information regarding indications, warnings, precautions, and potential adverse events.

Caution: Federal Law (USA) restricts these devices to the sale by or on the order of a physician.

The commercial name of the Evolut™ R device is Medtronic CoreValve™ Evolut™ R System, the commercial name of the Evolut™ PRO+ device is Medtronic Evolut™ PRO+ System, and the commercial name of the Evolut™ FX device is Medtronic Evolut™ System.
Freestyle™ Aortic Root Bioprosthesis

**Indications:** For the replacement of malfunctioning native or prosthetic aortic valves with the option of aortic root replacement. **Contraindications:** None known.

**Warnings/Precautions/Adverse Events:** Accelerated deterioration due to calcific degeneration of bioprosthesis may occur in: children, adolescents, young adults, and patients with altered calcium metabolism (e.g., chronic renal failure, hyperparathyroidism). Adverse events can include: cardiac dysrhythmias, death, endocarditis, heart failure, hemolysis, hemorrhage, transvalvular or paravalvular leak, nonstructural dysfunction, structural deterioration, thromboembolism, valve thrombosis, or intracapsular hematoma.

**Caution:** Federal law (USA) restricts these devices to sale by or on the order of a physician.

Mosaic™ Bioprosthesis

**Indications:** For the replacement of malfunctioning native or prosthetic aortic and/or mitral heart valves. **Contraindications:** None known. **Warnings/Precautions/Adverse Events:** Accelerated deterioration due to calcific degeneration of bioprosthesis may occur in: children, adolescents, young adults, and patients with altered calcium metabolism (e.g., chronic renal failure, hyperparathyroidism). Adverse events can include: angina, cardiac arrhythmia, cardiac dysrhythmias, death, endocarditis, infection other than endocarditis, heart failure, hemolysis, hemolytic anemia, hemorrhage, transvalvular or paravalvular leak, myocardial infarction, nonstructural dysfunction, stroke, structural deterioration, thromboembolism, or valve thrombosis.

**Caution:** Federal law (USA) restricts these devices to sale by or on the order of a physician.