

Please note: The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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## RESEARCH CORRESPONDENCE

# Supra-Annular Sizing for Transcatheter Aortic Valve Replacement Candidates With Bicuspid Aortic Valve



Patients with bicuspid aortic valve (BAV) undergoing transcatheter aortic valve replacement (TAVR) may experience suboptimal clinical outcomes (1). This can be the result of inappropriate prosthesis size selection, anatomic difficulties, or technical factors. Altered anatomies in BAV, such as heavily calcified and fibrotic leaflets and commissural fusion, are particularly challenging for prosthesis size selection.

Appropriate valve size selection is pivotal, as it can avoid paravalvular leak, embolization, and patient-prosthesis mismatch, among other complications. The goal of sizing is to optimize the interference between prosthesis and anatomy. Interference is affected by device design (i.e., radial force and conformability) and prosthesis oversizing. Interference occurs at multiple levels across the left ventricular outflow tract, annulus, and leaflets. The majority of this interaction likely occurs within the leaflets (2). In this regard, some investigators have suggested using balloon sizing or measuring the intercommissural distance for transcatheter aortic valve sizing for BAV, but the strategies were not thoroughly studied or were still in a preliminary phase. Here, we propose supra-annular (or “intraleaflet”) sizing for prosthesis size selection. In this report, we describe 3 cases of patients with BAV who underwent Lotus valve implantation using supra-annular sizing.

The supra-annular level is located within the aortic root and defined to be somewhere between 4

and 8 mm above the annulus (varying from patient to patient). Locating this level should appreciate the region where the prosthesis will be maximally constrained, typically in areas of bulky or maximal calcification or commissural fusion. When determining the supra-annulus, commissural gaps need to be sealed by the prosthesis. Commissural fusion, either by calcification or fibrosis, may influence the location of commissural gaps and act as a base for sealing against the prosthesis. Bulky calcifications within the sinuses can affect prosthesis expansion and conformability, so it is necessary to anticipate how much space is left for the prosthesis. A perimeter or an area can be circumscribed using the borders of leaflets (calcified or not) and areas of commissural fusion while making sure to seal commissural gaps.

Patient characteristics, pre- and post-TAVR multi-detector computed tomographic measurements, and hemodynamic performance at 1-month follow-up are summarized in **Table 1**. The supra-annular measurements were smaller than the “traditional” annulus circumscribed in all cases. All procedures were uneventful.

The purpose of the present case series is to demonstrate the feasibility of performing supra-annular measurements for transcatheter aortic valve sizing in patients with BAV disease. In all cases, the implanted transcatheter aortic valve was smaller in size than suggested by the “traditional” aortic annulus. Furthermore, the degree of paravalvular leak in each case was mild, mild, and none, respectively; mean transprosthetic gradients were <20 mm Hg at 1-month follow-up.

Traditionally, oversizing of the prosthesis is in relation to the aortic annulus (3). Oversizing across the leaflets, however, will be greater than that at the annulus because of the “volcanic shape” of the stenotic aortic valve, especially in BAV morphology or in the presence of heavily calcified leaflets. The increased oversizing across the leaflets can be excessive and not appreciated by annular sizing alone. An oversized prosthesis may increase the risk for annular rupture or conduction disturbances, whereas an undersized prosthesis may lead to significant paravalvular leak or prosthesis migration.

In the present case series, we demonstrate the feasibility of supra-annular sizing in patients with BAV morphology using the Lotus valve. It may be reasonable to extend this practice to all patients undergoing TAVR, because all stenotic aortic valves share the “volcanic shape” of valvular opening. Although further studies are needed, supra-annular

**TABLE 1 Patient Characteristics, Pre- and Post-Transcatheter Aortic Valve Replacement Multidetector Computed Tomographic Measurements, and Hemodynamic Performance at 1-Month Follow-Up**

	Case 1	Case 2	Case 3
<b>Baseline characteristics</b>			
Age, yrs	76	68	66
Gender	Male	Female	Male
Transvalvular mean gradient, mm Hg	63	55	46
Aortic valve morphology	Type 1 bicuspid (left-right)	Type 0 bicuspid	Functional bicuspid (left-right)
<b>Pre-procedural MDCT measurements</b>			
Valve size used, mm	25	23	23
<b>Annulus</b>			
Perimeter, mm	86.2	74.1	78.4
Area, mm <sup>2</sup>	565.0	402.4	463.4
Expected perimeter oversizing, %	-8.9	-2.5	-7.8
<b>Supra-annulus</b>			
Distance above the annulus, mm	7	6	8
Perimeter, mm	73.2	65.5	71.1
Area, mm <sup>2</sup>	391.8	335.0	341.9
Expected perimeter oversizing, %	7.3	10.3	1.6
Calcium burden (volume, mm <sup>3</sup> )	Severe (1,021.6)	Moderate (601.9)	Moderate (717.2)
<b>Post-procedural MDCT measurements</b>			
<b>Frame level at the annulus</b>			
Perimeter, mm	73.1	64.1	70.1
Area, mm <sup>2</sup>	419.5	326.1	388.5
Interference, %	6.9	11.3	3.0
<b>Frame level at the supra-annulus</b>			
Perimeter, mm	64.6	54.4	65.4
Area, mm <sup>2</sup>	310.7	234.5	337.5
Interference, %	17.7	24.7	9.5
<b>Hemodynamic performance at 1-mo follow-up</b>			
Transvalvular mean gradient, mm Hg	15	19	14
Paravalvular leak	Mild	Mild	None

sizing may provide an option for patients whose annuli are too large for any commercially available transcatheter aortic valves.

The concept of supra-annular sizing emerged from analyses of post-TAVR multidetector computed tomography, which suggested that the prosthesis interacts across the region of the aortic annulus and aortic valve leaflets. The prosthesis appears to conform according to the pattern of commissural gaps, calcifications, and leaflet morphology. The recognized patterns of post-deployment prosthesis shape were the impetus for the supra-annular sizing algorithm.

Comparative studies between supra-annular and annular sizing are currently lacking and should be the focus of future studies.

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## RESEARCH CORRESPONDENCE

# Transcatheter Edge-to-Edge Repair for Severe Tricuspid Regurgitation Using the Triple-Orifice Technique Versus the Bicuspidalization Technique



Transcatheter edge-to-edge repair has been shown to be an alternative treatment option in selected inoperable patients with severe tricuspid regurgitation (TR) (1). However, the optimal clip placement strategy remains to be established. Reduction of TR can be achieved by a triple-orifice technique (TOT) (Figures 1A and 1B), where clips are ideally placed