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Deformation Differences between Tricuspid and Bicuspid Aortic Valves in Vitro KAI SZETO, UC San Diego, JAVIER RODRIGUEZ-RODRIGUEZ, UC3 Madrid, PETER PASTUSZKO, VISHAL NIGAM, JUAN C. LASHERAS, UC San Diego — It has been shown in clinical studies that patients with congenital bicuspid aortic valves (CBAVs) develop degenerative calcification of the leaflets at young ages compared to patients with the normal tricuspid aortic valves (TAVs). It has been hypothesized that the asymmetrical geometry of the leaflets in CBAVs, flow shear stresses (SS), disturbed flow, and excessive strain rate levels are possible causes for the early calcification and stenosis. Central to the validation of this hypothesis is the need to quantify the differences in strain rate levels between the BAVs and TAVs. We simulate the CBAVs by surgically stitching two of the leaflets of a porcine aortic valve together. To quantify strain differences, we performed in-vitro experiments in both trileaflet and bileaflet valves by tracking the motion of small ink dots marked on each leaflet surface. We then used phase-locked stereo photogrammetry to reconstruct at each instant of time the 3D surface of the leaflets and measure the strain rates in both radial and circumferential directions during the whole cardiac cycle. Our results indicate that the total strain rate of the simulated BAVs is about 15 to 20% higher than the normal leaflets of TAVs at systole. In the BAVs' case, the fused leaflet stretches radially up to 25% higher than the reference length. The excessive stretching in both directions in the fused leaflet results in large changes in the flow patterns and associated wall SS.

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