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Characteristics of Pulsatile Flow Through Deformed Aortic Arch Models: A Tomographic PIV and CFD Study. YAN ZHANG, RUIHANG ZHANG, AL HABIB ULLAH, NICK THOMAS, JORDI ESTEVADEORDAL, YILDIRIM SUZEN, North Dakota State University — Romanesque and Gothic aortic arches are two types of deformed arch geometries after surgical repair of coarctation of the aorta. The abnormal geometry, particularly the Gothic type, is commonly associated with systemic hypertension and other cardiovascular complications in part due to irregular hemodynamics. In this study, the pulsatile flow characteristics of deformed arch models were investigated using phase-locked tomographic particle image velocimetry and computational fluid dynamic simulations. A flow waveform of 5 liters/min with a heart rate of 60-100 beats/min was used as boundary conditions for both in vitro pulsatile flow simulator and CFD simulations. The variations of flow patterns and average and fluctuation of velocity were analyzed at specific critical phases of a heart cycle. Results reveal distinct 3D flow characteristics in Romanesque and Gothic arch models. Flow separation occurs in the gothic arch model, causing a jet flow impinging on the outer wall of the descending aorta. Different arch curvatures also result in different secondary flow patterns around the arch. The separation jet and altered secondary flows are linked with irregular wall shear stress that are potentially associated with systemic hypertension and atherosclerotic lesions.

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