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Effect of Cartilaginous Rings in a Model of Human Trachea with Stenosis HUMBERTO BOCANEGRA EVANS, JOS MONTOYA SEGNINI, ALI DOOSTTALAB, Purdue University, JOEHASSIN CORDERO, Texas Tech University Health Sciences Center, LUCIANO CASTILLO, Purdue University — The human trachea is structurally supported by a series of cartilaginous rings, which introduce corrugations along the wall surface. Nevertheless, the airway walls are generally considered smooth for respiratory fluid dynamics research purposes. Previous results by Bocanegra Evans and Castillo (J. Biomech., 49, 1601, 2016) demonstrate that these rings have a significant impact on the flow separation found in the tracheobronchial bifurcation. Here, we study the effect that such rings have in a trachea model with stenosis. We present an experimental comparison of smooth and 'ringed' models with a grade II (70% blockage) stenotic contraction. Particle image velocimetry measurements are carried out in a refractive index-matching facility simulating resting breathing state conditions (ReD = 3,350). Our results show that cartilaginous rings induce velocity fluctuations in the downstream flow, which enhances the near-wall momentum flux and reduces flow separation after the stenosis. The maximum upstream velocity of the recirculation is reduced by 38% in the model with rings, resulting in a weaker recirculation zone. These results highlight the importance of the cartilaginous rings—and other small features—in respiratory flows.

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