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Viscous Flow Structures Downstream of a Model Tracheoesophageal Prosthesis FRANK HEMSING, BYRON ERATH, Clarkson University — In tracheoesophageal speech (TES), the glottis is replaced by the tissue of the pharyngeoesophageal segment (PES) as the vibrating element of speech production. During TES air is forced from the lungs into the esophagus via a prosthetic tube that connects the trachea with the esophagus. Air moving up the esophagus incites self-sustained oscillations of the surgically created PES, generating sound analogous to voiced speech. Despite the ubiquity with which TES is employed as a method for restoring speech to laryngectomees, the effect of viscous flow structures on voice production in TES is not well understood. Of particular interest is the flow exiting the prosthetic connection between the trachea and esophagus, because of its influence on the total pressure loss (i.e. effort required to produce speech), and the fluid-structure energy exchange that drives the PES. Understanding this flow behavior can inform prosthesis design to enhance beneficial flow structures and mitigate the need for adjustment of prosthesis placement. This study employs a physical model of the tracheoesophageal geometry to investigate the flow structures that arise in TES. The geometry of this region is modeled at three times physiological scale using water as the working fluid to obtain nondimensional numbers matching flow in TES. Modulation of the flow is achieved with a computer controlled gate valve at a scaled frequency of 0.22 Hz to mimic the oscillations of the PES. Particle image velocimetry is used to resolve flow characteristics at the tracheoesophageal prosthesis. Data are acquired for three cases of prosthesis insertion angle.

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